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SURVEY OF THE UNITED STATES TUNA INDUSTRY

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CURRENT FISHERIES LITERATURE

Editor: D. B. Finn

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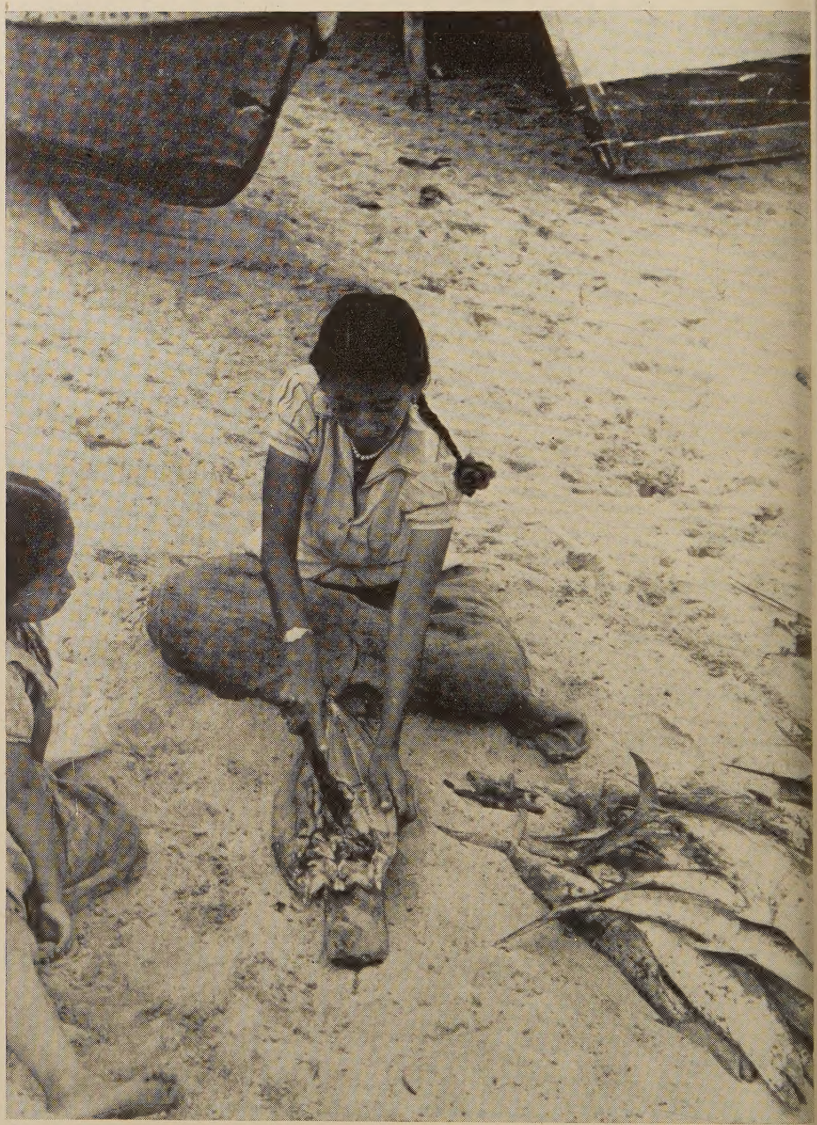

A woman in Ecuador dressing "sierra" (Spanish mackerel, *Scomberomorus maculatus*) on the sand of the beach. Gills and viscera are taken off and deep cuts along the fish, from the collar bone to the tail, are made for wet salting.

THE PRESERVATION OF "WET" FISH[1] [2]

Part 1

Introduction

Most of the papers included in this review are those which report *experiments* on cooling and handling of wet fish and on the use of preservatives and disinfectants. Papers describing only common practice and legislation on fish handling, and papers on grading of fish (estimation of freshness) have, for the most part, been left out. Furthermore, stress has been laid on the principles of the methods of fish handling and chilling, and not on the technical details, such as the type of insulating materials in boats and machinery for refrigeration. Construction of fish holds will be dealt with in Part 2 of the Group's report.

All the existing evidence goes to show that bacterial activity is by far the most important factor in spoilage of wet fish (70). [3] On the other hand, chemical changes in the fat and autolysis, may, under certain circumstances, play an important rôle. It seems probable that the very early changes in odor and flavor of the flesh of summer herring which, after catching, is kept near 32° F. (0° C.), are not bacterial but enzymatic in character and occur before the bacterial lag phase is over. In such fish, ingestion has outrun assimilation and the tissues contain unconverted plankton oil (68).

The temperature of storage of fresh herring may also influence the relative significance of bacterial spoilage versus autolysis and development of rancidity in such a way that the former becomes less important when the storage temperature decreases (75).

Most of the researches have been devoted to the bacterial spoilage. The reason for this is probably not only the important rôle of bacteria, but also that codfish (and related species) have been a more common object in such research than any other fish. Contrary to what is the case with fatty fish, such as herring, autolysis and particularly the development of rancidity, do not play any evident rôle in the spoilage of codfish. However, it has been noted that palatability of codfish may be reduced to 60 percent of that of fresh fish, before tastes

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1 The first report of Working Group 3 of the FAO Interim Committee on Fish Handling and Processing (in two parts). The Committee consists of fisheries technologists from various countries who exchange information and ideas so that most recent technological advances can be brought to bear upon the development of trade by the improvement of quality. The work of this Group covers storage of fish close to freezing temperatures, and the purpose of the report is to summarize existing knowledge on the subject, and to point out fields of research of most immediate interest. Part 2 will be a report dealing with "Design Features in 'Wet' Fish Holds" [For previous mention of the Committee, *see FAO Fisheries Bulletin* Vol. VI, (1/2), 51 ; (4), 135-39 ; (6), 246-47].

2 Compiled by H. Riemann and F. Bramsnaes, Technological Laboratory, Ministry of Fisheries, Copenhagen, Denmark.

3 Figures in parentheses refer to references in the bibliography, pp. 60-65.

and odors characteristic of spoilage become noticeable (34). It is not known whether this reduction of palatability is due to autolysis. The lack of research on spoilage produced by changes in the fat can be illustrated by the fact that although many experiments have been made on the value of the bacteriostatic properties of disinfecting compounds, hardly any work appears to have been done on the effect of anti-oxidants on chilled fish (28).

The literature on the physiology of spoilage of fish was excellently reviewed a few years ago (70) and will be dealt with here in regard to certain details only.

II. Effect of Chilling on Spoilage

The bacteria associated with spoilage of chilled fish belong to the so-called cold-loving species, which are still active at low temperatures, about 32° F. The groups mainly responsible for spoilage are the Achromobacter, the Flavobacter and the Pseudomonas (70). The Flavobacter seem to be less active than the Pseudomonas and the Achromobacter (18, 23).

Although the spoilage bacteria are considerably active at low temperatures, they are markedly inhibited by small decreases in temperature around 32° F. (4, 44, 45, 46, 48, 51). This inhibition has been demonstrated in many experiments on the keeping quality of chilled fish, where fish stored at or below 32° F. kept much longer than fish stored a few degrees above 32° F. (2, 13, 14, 20, 31, 35). Codfish may spoil twice as fast at 37° F. (2.7° C.) than at 32° F. Experiments with herring in weak salt solutions showed similar results (74). There is no doubt that temperature is a factor of overwhelming importance in the retention of quality of chilled fish, but it also seems true that due attention has not been paid to this factor in practical handling and storage of fish. The temperature of commercial fish (codfish) aboard fishing boats may be several degrees above 32° F., e.g. 33° to 34° F. (0.5° to 1° C.), and sometimes 44° F. (6.6° C.) (30, 31), because of faulty or insufficient icing (57), let alone the cases where fish are iced several hours after catching or not iced at all. The chilling of fish is most commonly done with ice, which is almost ideal for this purpose. Ice will cool even warm fish to about 32° F. in a few hours if used properly and in sufficient amounts. When iced fish is not chilled to 32° F. the reason is solely that the fish has not been in close contact with ice or that the ice has melted away because the amount has been too small. The ice has to perform the double function of cooling the fish rapidly to 32° F., and of keeping at this temperature during storage. These two requirements can be fulfilled always if the fish are stored in intimate contact with a sufficient amount of ice, and if sufficient ice is placed at the danger spots in the hold of the boat, where the insulation against heat transmission from outside is poorest (5, 57, 68, 69, 70, 84). The amount of ice required depends on several fac-

:s (amount of fish, temperature of fish, insulation of the boat, out-
le temperature, length of the trip).

Considerable amounts of ice may be saved by insulation or arti-
ial cooling of the hold of the boat (29, 57, 59, 70, 84). Several
ats have been equipped with refrigeration or insulation with good
actical results.

The insulation and refrigeration not only save ice, but also pre-
nt the fish from being leached out by excessive amounts of melted
water. Large amounts of ice water have been found to wash
t substantial quantities of flavoring substances, amino acids and
oteins from the fish flesh (33).

The rate at which fish is cooled, when packed in ice is indepen-
nt of the air temperature (25, 64), but depends on the size of the
particles (64, 108). Finely crushed ice has a greater surface than
arse ice and therefore cools the fish more rapidly. Finely crushed
should therefore be used for fish. Snow is used with good results
04), but some prefer flake-ice to snow, because the layer of snow
nds to crack during storage, so that the fish does not remain com-
etely covered (78).

The cooling process is greatly influenced by the quantity of ice
board, but not by the kind of packing. The curve of the relation-
ip between the quantity of ice and the duration of cooling shows
at if the quantity of ice is less than 75 percent of the mass
fish being cooled, the duration of cooling at $Z_{+1^\circ}^{+2^\circ}$ increases
pidly and reaches infinity with a quantity of ice of 25 percent.
his means that for proper (i.e. rapid and even) cooling of raw fish
is necessary to use a considerable quantity of ice at relatively low
mperatures of the fish and the air (64).

The melting point of water ice is 32° F. A lower temperature
ould be preferable and can be obtained in several ways. Sea water
3 percent salt solutions can be cooled to 29° F. (-1.6° C.) and have
en suggested for cooling fish in wells (84). The principle is applied
tuna boats, but it is unlikely that it will be commonly used in other
pes of fishing boats (69).

A fishing vessel has, however, recently been equipped with a
w type of tank in which the fish can be rapidly cooled down and
pt at a temperature of 29° to 30° F. in mechanically refrigerated
a water: this type of tank seems to work satisfactorily (54).

Another method is to use eutectic ice. Eutectic salt-water ice
s a "melting point" of -6° F. (-21° C.) and cannot therefore be
ed directly on fish. Eutectic ice with $NaHCO_3$ [m.p. 28° F., (-2° C.)]
d Na_2HPO_4 [m.p. 30° F., (-1° C.)] has been used with promising
sults; but these two salts must be used in a concentration of 2
3 percent. The fish will therefore absorb some salt, which may
eed up the development of rancidity during the subsequent freezer
orage (43, 83). Dry ice sublimates at a temperature of -109° F.
79° C.) and absorbs nearly twice as much heat as water ice. Com-
ned use of dry ice and water ice has been tried in experiments
ith some success (43); besides its cooling effect, dry ice may possibly

exert a direct bacteriostatic effect on account of the CO_2 liberated as gas.

Instead of using eutectic salt water ice, ordinary ice may be mixed with small amounts of salt (NaCl), in order to obtain a temperature slightly below 32° F. It is difficult, however, to get a uniform temperature in such mixtures (108). This difficulty is claimed to be overcome by cooling the fish (sprats) in barrels containing a mixture of salt, sea water and ice (52).

It is perhaps theoretically possible to keep the fish at temperatures slightly below 32° F. without ice by storing them (after precooling) in a hold, where the temperature of the air is kept at, say 30° F. by artificial refrigeration. Application of this method in commercial fishing, however, is very questionable. On the other hand, fish suffer in quality if they are dried superficially during storage (62) they would, therefore, have to be covered in some way.

None of the methods mentioned of storing chilled fish at temperatures below 32° F. seem to have been commercially used. In view of the importance of low temperatures for storage of chilled fish it might be worth while to reconsider these and other methods. However, the first goal from a commercial point of view must be to make full use of the potentialities of water ice, i.e. to use the ice and construct the boats so that the temperature of all fish in the hold is lowered as much as possible and kept at a low temperature during the whole trip.

Recent British experiments (73) have shown that fish (codfish) may be cooled to temperatures below 32° F. by using ordinary water ice. Experiments as well as temperature measurements in fish stowed in commercial fishing vessels indicate that temperatures as low as 28° to 29° F. (-2.2° to -1.5° C.) may be obtained in the fish. The cause of the temperatures below 32° F. being reached in fish iced with ordinary water ice is not fully known. It is probable, however, that the sea water with which the fish are washed, plus a certain amount of body fluids, when in contact with the ice, cause a depression of the melting point of the ice.

The above findings concerning chilling of fish apply to storage in fishing boats as well as to storage and transport on land. There are, however, greater chilling possibilities on land. Where freezing plants are situated near the fishing ports, the landed fish may be efficiently chilled by partial or complete freezing before distribution to the retailers in insulated vehicles (58, 69).

Although the effects of storage temperature on keeping quality are well established, little is known of the effect of a temporary warming up of the fish. It is a general experience that fish should be iced as soon as possible after catching, and it has been found that storage without ice on the deck for a few hours, especially in sunlight, may increase the temperature of the fish considerably (27, 42) and consequently shorten the keeping quality in ice by several days (22, 102). It has also been found that the bacterial flora of fish goes into the logarithmic growth phase, if the fish are left 24 hours at

°F. (15.5° C.) (85). This observation is in good agreement with results btained with pure cultures of spoilage bacteria (44, 45, 46, 51). But tle seems to be known of the effect on bacterial growth and keeping uality of temporary rises in the temperature of the fish during unload-g, auctioning, repacking and other handling, where the ice is re-oved from the fish. Experiments have shown, however, that fish ex-osed to temperatures of about 50° F. (10° C.) for from 8 to 13 hours ere, after two days' further storage in ice, notably poorer than the ntinuously iced controls. The keeping quality was, in fact, lower y about 1 to 3 days, as compared with the controls (55, 73). In other od industries the raw material is successfully converted into the al product, and perishable goods distributed before the termination the lag phase of the contaminating bacteria. This is not always ssible with fish, partly because they contain spoilage bacteria which e able to grow at unusually low temperatures. But it might well e worth while to make flow sheet analyses to find out the effect the more or less inevitable temporary de-icing of fish, on (*a*) the mperature of the fish, (*b*) the bacterial growth, and (*c*) the subse-uent keeping quality.

Most of the experiments on chilling of fish have been made with gard to the bacterial spoilage of codfish. Much less attention has een paid to the early autolytic (enzymatic) changes which seem to ake place in herring feeding on zooplankton ; but it seems clear that hese changes also are slowed down by lowering the temperature (69). lthough the effect may not be as great as on the bacteria.

II. Effect of Handling on Spoilage

As mentioned in the preceding paragraphs, handling may adversely nfluence the keeping quality by exposing the fish to high temper-tures, but bad handling may also have a detrimental effect in a number f other ways. If fish are handled roughly, they may be bruised and eavy contamination may occur as a result of unclean conditions.

Much advice concerning handling of fish has been given in most ountries, but little of it seems to be founded on evidence obtained y experiments.

Gutting

It seems to be a general experience that keeping quality is lower-d when fish are not gutted before storage, and this is supported by xperiments (1, 21, 70, 102). This applies to the larger species (white ish). The bad effect of leaving the guts in the fish may primarily e autolytic, because it has been found that spoilage products [trime-hylamine (TMA), and volatile acids], which are produced in the ntestines, do not diffuse out into the flesh as long as the intestines of haddock) are intact (66) ; these spoilage products are formed apidly in the belly cavity of gutted fish (31). The flesh of gutted ish may therefore have a higher content of the above-named spoilage

products than similar ungutted fish (66). It has, consequently, been proposed (66) that fish (haddock) should be stored in the round state.

In experiments with herring, it has been found that gutting and splitting in different ways did not improve the preservation of fresh flavor. However, the herring had been stored for some time before evisceration (69). It is an old experience in the salt herring industry that herring which feed on certain organisms are unsuited for curing, even when gibbed, because of autolytic processes which, in a short time, " dissolve " the tissue around the belly cavity, despite the high concentration of salt used. This type of spoilage is not confined to herring, but may occur in numerous other species, e.g. well-iced mackerel, less than 24 hours out of water, may be completely spoiled as a result of such action ; the spoilage may be accompanied by hydrogen sulphide formation in the tissue near the backbone (79).

Washing, Rough Handling, etc.

Careful gutting and washing and cautious handling combined with clean conditions on board are reported to enhance the keeping quality (6, 63, 69, 70), but few experiments are published showing the relative importance of these various factors.

It is claimed that fish should be washed before storage in the hold (63, 69), and that washing in unclean water may contaminate the fish to such an extent that the keeping quality is lowered (63). Experiments (cod and haddock), however, did not show any adverse effect of not washing or of washing in unclean water (22). Rough handling of fish (cod and haddock) on the deck did not impair the subsequent keeping quality (22). " Rough " handling by storing in thick layers does not always lower the keeping quality (69, 70), but may produce large weight losses (26).

Cleaning and Disinfection of Holds, etc.

It has been shown that the keeping quality (codfish) may be prolonged by about 30 percent by thorough cleaning of all surfaces with which the fish come in contact (70). Experiments with herring stored for 40 hours showed no difference between sterilized metal boxes and new or well-washed wooden boxes (71). Disinfection of boxes has been recommended (77), but it does not seem to be necessary to do more than wash and brush the boxes carefully (68). A number of papers have been published on the effect and the use of different disinfectants (10, 77, 81, 82, 88). Chlorine solutions seem to be the most preferred. Calcium hypochlorite is an efficient deodorant for holds in the fishing boats (102).

It is perhaps surprising that disinfection of equipment, etc., which is so commonly used where other foodstuffs (notably milk) are handled, does not improve the keeping quality of fish ; but it must be borne in mind that the fish themselves contain more bacteria capable of growing at low temperatures than any other foodstuffs, and that a tenfold

ise in the initial bacterial count of fish (codfish fillets) may reduce he keeping quality at 32° F. by only two days or so (12).

Contaminated Ice

One potential source of contamination, which apparently has not been much examined, is the ice. It is known that ice made from comparatively clean water contains only a few bacteria after cold storage under clean conditions, because spoilage bacteria die out quickly, specially at low temperatures (24, 48, 49). There are observations, however, which indicate that ice may be heavily contaminated during handling and storage (3, 24, 27, 102), especially when it is stored or long periods in the hold and, for instance, when new ice is piled n top of the old ice (24). Beneficial effects from ice made from chlo- inated water have been reported (56).

It may be concluded from the available literature that, in spite f many valuable contributions made in this field, more research is eeded to find the relative effect of each of the various factors which nfluence the keeping quality. Such research could be carried out by arying a single factor at a time, and otherwise along similar lines s hitherto, namely, by noting the effect on the bacterial flow sheet nd the keeping quality (organoleptic tests, chemical analyses). All ther factors must, of course, be kept constant. To get a complete icture, it would be necessary to investigate the fishing and handling f different species of fish with different gears and in different seasons.

Filleting

In view of the fact that bacteria do not invade the muscle tissue ntil the fish (codfish) are noticeably spoiled (30, 31, 102, 106), it is emarkable that the keeping quality of fish (cod) is not improved, when more than 99 percent of the bacteria are removed by washing, fter the fish have been kept in ice a few days (19, 102). In contrast o this, the removing of bacteria during filleting results in an increas- d keeping quality. If the filleting is done under good sanitary con- itions in the laboratory, the keeping quality of the fillet is better han that of the round fish (32, 38).

Assuming that the sanitary conditions were ideal the fillets may e made with an initial contamination of 10 bacteria per cc. Such fillets nay keep 12 to 13 days at 38° F. (3° C.) even if the fish has been ept in ice several days prior to filletting. If the initial contamination s 10^5 to 10^6 bacteria per cc. the keeping quality of the fillets is not nore than 4 days at 38° F. (3° C.). At 32° F. it might be expected hat the difference in keeping quality between the two lots of fillets would be about 16 days, instead of 8 to 9 days (12, 20). It has been ound, in practice, that fillets produced from iced codfish may leave the lant with an initial contamination of 10^6 bacteria per cc. (9). Many xperiments have been made for the purpose of reducing the contamin- tion of the fillets. Washing drums have been constructed and it

has been shown that washing the fish before filleting reduces the bacterial load on the fillets and makes them keep better (15, 16, 94). Modern, easily cleaned filleting tables, where the fish are transported in troughs with clean running water, have been found to improve the keeping quality (40, 105, 107). The practice of keeping the stream of clean water running over the cutting board during filleting (84) may also add to the keeping quality of the fillets. The same effect is obtained by the use of mechanical skinners, instead of hand-skinning (16). Another improvement in the handling of fillets is to dip them into a sodium nitrite solution (*see* below), and a machine for semi-automatic dipping has been constructed (53). The cooling of the fillets to temperatures about 32° F. may be speeded up if the fillets, packed in metal boxes, are kept in a blast freezer until partially frozen (58), or if the fillets are dipped in ice water.

Almost all the experiments with fillets referred to above have been made with cod and similar species, but like results could probably be obtained with any fish.

IV. Effect of Preservatives on Spoilage

Many experiments have been made on the effect of preservatives and disinfectants on the keeping quality of fish, but only a few have resulted in commercial applications.

Disinfectants

Water (for ice production, etc.) may be effectively disinfected with chlorine (8, 10, 28, 56) or formaldehyde (3). Washing of skinned shark with chlorine (0.05 percent available chlorine) has been found to improve its keeping quality (50). Ice with 0.02 percent chlorine, as well as dips into 0.6 percent chlorine, inhibited spoilage, but produced discoloration of halibut (103). Dips into 0.02 and 0.05 percent chlorine showed no preserving effect (11, 27). Fillets (cod, haddock, sole), which have been dipped for 5 minutes into 0.02 to 0.03 percent chlorine, developed discoloration and off-flavor (11). In consequence, chlorine cannot be recommended as an improver of keeping quality, except, perhaps, for big fishes like shark and large tuna.

Salt and Acid

Dipping halibut for 30 minutes into 20 percent brine kills or inhibits *Pseudomonas fluorescens* effectively. The skin absorbs 15 to 20 percent salt by this treatment, but most of it is washed out during the subsequent storage in ice. The brine coagulates the slime and changes the appearance of the fish (47). A handful of salt added to the belly cavity of stockfish (cape hake, *Merluccius capensis*) prior to icing improved the keeping quality more than dipping into solutions of sodium nitrite, quaternary ammonium compounds and tannic

acid (78). Dipping of fillets (halibut and flounder) for 1 and 5 minutes in 10 to 20 percent brine prevented weight losses completely during storage for 20 days or more at 32° to 35° F. (97, 99). Flounder fillets absorbed 1 to 1.5 percent salt during a 1 minute dip in 15 percent brine (99). A 5 minute dip in 15 percent brine had no significant effect on bacterial growth in fillets (flounder, halibut) (80).

The hydrogen ion concentration (pH) is probably one of the major factors influencing the progress of spoilage (76), e. g., halibut does not spoil rapidly as cod because of the naturally lower pH of the former. It is, however, difficult to lower the pH of fish flesh artificially without damaging its flavor, appearance or consistency.

Dipping of fillets for 5 minutes in saturated brine containing 0.036 to 0.072 percent hydrochloric acid prolonged the keeping quality at 45° F. (7° C.) by 3 days, without impairing the flavor or quality seriously. A similar effect was obtained when the whole fish was dipped for 1 minute in saturated brine containing 1.2 percent hydrochloric acid, but the appearance of the fish was adversely affected (41). Dipping fillets (cod) in 1.5 to 1.8 percent lactic or citric acid improved the keeping quality considerably (60). Such dips produced a weight loss in the fillets (halibut and flounder) of 20 to 30 percent during 14 to 26 days' storage at 39° F. (4° C.) (80).

Radiation

Electrons (cathode rays) may kill bacteria in fish without raising the temperature of the flesh by more than 3.6° F. (2° C.), but rays from generators used hitherto have had a maximum penetration of only 1.5 cm. (0.6 in.) in fish flesh (61, 66).

Ultraviolet radiation has been found to reduce the bacterial count on fillets (67, 101), but has only a slight, if any, effect on the keeping quality (101, 102). Ultraviolet light is effective for disinfection of brine, etc., for dips, but requires fairly long exposures (109).

It has been reported in newspapers that fillets have been successfully treated with ultrasonic waves.

Carbon Dioxide

Carbon dioxide has been found to be an effective bacterial inhibitor in concentrations exceeding 40 percent, in conjunction with the normal storage in ice. However, although not repulsive in odor and flavor, the fish tend to become soft in texture and unattractive in appearance when the percentage of CO_2 is high (70). Owing to the possibilities of such treatment being cheaper than icing and considering the labor involved in icing, it is felt that practical trials with carbon dioxide already initiated should continue (69).

Chemical Preservatives Other than Nitrite and Hydroxylamine

Concentrations of 0.001 to 0.002 percent sulphathiazol or 0.002 percent sulphanilamide have less growthinh-ibiting effect on bacteria in fish flesh (spring salmon, ling cod and halibut) at 0° C. than 0.02

percent sodium nitrite. Penicillin G (5 to 75 I. U. per 100 g.) and streptomycin (100 to 1,000 "S" units per 100 g.) had no significant effect (93). 0.01 percent penicillic acid and 4-methoxy-2 :5 toluquinone showed no growth-inhibition on bacteria in fish flesh (halibut salmon), 0.1 percent had a feeble effect. Methyl bromide had no inhibiting effect, but ethylene oxide, propylene oxide, ethyl formate and methyl formate gave considerable inhibition, when applied in solution. Concentratione of 0.1 to 1.0 percent were necessary to get any effect. Ethyl formate and methyl formate gave the fish flesh a coagulated appearance. Ethylene glycol, propylene glycol, trimethylene glycol, glycerol formate, chloroform and 1 : 4 dioxane did not significantly inhibit bacterial growth in fish flesh. 0.02 percent sodium nitrite was more effective than any other of the named compounds (86).

Fillets (flounder and halibut) were dipped for 1 hour into 2 percent brine at 35° F. (1.6° C.) to which different preservatives had been added. The keeping quality of the dipped fillets stored at 35° F. was tested with the following results : 0.1 percent hydrogen peroxide, 0.7 percent hydrochloric acid and 0.1 percent boric acid had no significant effect. 0.1 percent sulphur dioxide inhibited bacterial growth, but affected adversely the odor and the appearance of the fillets. 0.7 percent chloroform was effective ; it disappeared during storage. Benzoic acid and sodium benzoate were more effective than boric acid and the ethyl ester of the parahydroxybenzoic acid. Potassium nitrite was very effective (96).

Storage of fish (sprats) at a temperature of about 32° F. in brine containing 0.05 percent tannic acid has been found to be beneficial (52).

Glucose, 0.01 percent, together with potassium iodate, 0.002 percent, inhibited spoilage of press juice from cod muscle considerably (39).

Aureomycin and terramycin in concentrations of about 10 p.p.m. have a striking inhibiting effect on growth of bacteria in fish flesh (95). These two antibiotics are fairly stable in fish flesh (7).

A number of preservatives and disinfectants have been tried in ice used for chilling fish. Good results were obtained (fresh water fish) with the following compounds in ice : 0.02 percent sodium nitrite + 1.5 percent sodium chloride, 0.005 percent trypaflavin + 0.01 percent formic acid, 0.01 percent Irgafen-Na (sulphonamide) + 0.01 percent formic acid + 0.15 percent hydrogen peroxide, 0.05 percent Irgafen-Na + 0.05 percent formic acid, 0.05 percent Irgamid-Na (Sulphonamide), 0.08 percent sulphathiazol, 0.05 percent sodium nitrite. Slight effects only were obtained with 0.05 percent Halazone (p-dichloraminobenzosulphonic acid), 0.1 percent Zephirol (quaternary ammonium compound), 0.1 percent lactic acid, 0.05 percent formic acid. No effect was obtained with 0.1 percent Quartamon (quaternary ammonium compound), 0.05 percent sulphacetamide or 0.15 percent hydrogen peroxide (65). 0.01 to 0.02 percent sulphanilamide, 0.01 percent sulphathiazol, 0.067 percent chloramine B + 0.067 percent sodium benzoate had comparatively good effects in ice. Chloramine B, chloramine R, rivanol (2 - ethoxy - 6 :9 diamino-

eridiidine-hydrochloride), penicillin, No-Bac, (benzoate and chlor-amine T), Roccal (alkyldimethylbenzylammonium chloride) and Emulsept [10% aquasol of N- (acyl colaminoformylmethyl) pyridium chloride] had a slight, or no effect in ice (83, 89).

0.1 percent benzoic acid in ice did not improve the keeping quality of fish (halibut and cod) significantly, but kept the ice sterile (91).

Ice containing Foromycen (a formaldehyde product), compared with ordinary ice, did not show any effect until the fish (plaice) was almost spoiled (102).

It seems to be a general rule that most preservatives exert a greater effect in slightly acid media than in neutral or alkaline media (83).

Nitrite and Hydroxylamine

The improving effect of nitrite on the keeping quality of fish has been reported in numerous papers.

The growth-inhibiting effect of nitrite (200 p.p.m. or below) on bacteria is pronounced at pH 6.0, but not significant at pH 7.0. Nitrite prevents the bacterial reduction of trimethylamineoxide (TMAO) and this effect is much less dependent on the pH of the fish flesh. Nitrite may also inhibit formation of tyrosine and possibly other spoilage products. It has also a good preserving effect on such fish (e. g. fresh water fish, sea fish on the Canadian west coast), where rereduction of TMAO does not play a significant rôle during spoilage.

Nitrite in fish flesh is reduced and disappears during storage, which makes it an almost perfect preservative (17, 36, 37, 98, 100). Some difficulties have occurred when nitrite is used in ice. When the ice is produced in the most common way, i.e. in blocks, the nitrite tends to concentrate in the center of the block. It is true that, at the subsequent crushing of the ice, a fairly even mixture is obtained. However, because the lumps with the highest concentration of nitrite have the lowest melting point, the nitrite tends to be unevenly distributed in the melting ice. This applies particularly to non-insulated and non-refrigerated holds, and the same is probably true for ices with other preservatives (102). Nitrite has a low toxicity (92) and is allowed in fresh fish in Canada in concentrations up to 200 p.p.m. ($NaNO_2$).

Hydroxylamine has a more pronounced growth-inhibiting effect than nitrite and is less influenced by the pH. The present knowledge about the toxicity of hydroxylamine is too limited, however, to permit this compound as a preservative (72, 87, 90).

The whole picture of preservatives in connection with chilling of fish needs more elucidation. Apart from more detailed experiments with a small number of products, for instance nitrite, the investigations have only been very superficial. Many of the preservatives can be ruled out straight away on the grounds of toxicity for humans, but others seem to justify closer examination.

V. The Physiology of Spoilage Bacteria

Many important papers have been published on the physiology, etc., of spoilage bacteria. They are, for the sake of brevity, not reviewed here. Such a review should, however, be made and serve as a basis for the planning of future experiments.

VI. The Physiology of the Fish

There is not much that has been published on the effect of the condition of the fish itself on the keeping quality. This is a field deserving more research and the work already done (physiological state of the fish, *rigor mortis*, species of fish, etc.) should, therefore, be followed up with more experiments.

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4

SURVEY OF THE UNITED STATES TUNA INDUSTRY

Introduction

The Secretary of the United States Department of the Interior, in response to a request from several senators of the Congress, instructed the Fish and Wildlife Service of his Department to initiate and carry out a study of the tuna industry of the United States. Following this study a comprehensive report was issued thereon in July 1953.

The nine chapters of this report contain an extensive survey of the industry and its various aspects. Each chapter is introduced by a summary of its contents. The following article, with a few minor editorial changes, comprises a selection of extracts from these summaries.

For statistical details and detailed text and analysis, the reader is referred to the original report – " Survey of the Domestic Tuna Industry, " *Special Scientific Report*: *Fisheries* No. 104, available from the United States Department of the Interior, Fish and Wildlife Service, Washington 25, D.C., U.S.A.

I. World Production

Tunas comprise a renewable biological resource not limited to continental shelves and unknown in potential production. Although much work has been done to discover tuna grounds and to develop methods of capture and use, the ir elementary biological features are only beginning to be understood. Occurrence of tuna in commercial quantities has been correlated with current patterns in warmer seas.

The principal areas now being fished are the Pacific Ocean near the coasts of Asia and North and South America, and the Atlantic and Mediterranean waters off southern and western Europe. In some parts of the world (Peru, Angola, the east coast of Australia, the Norwegian Sea, and the north-east United States) development of tuna fisheries has begun, and substantial production has been achieved in some instances.

Unexplored areas favorable for the existence of commercial quantities of tuna appear to be in: (1) the equatorial circulation of the Atlantic and Indian Oceans; (2) the north-eastern Pacific gyral; (3) the current flowing northward off western Australia, and (4) the Gulf Stream where it meets the coastal waters along North America.

It is thought that landings can be maintained in heavily exploited areas and increased on a world-wide basis. The United States catch could be greatly increased by adopting methods for taking subsurface stocks not now exploited, and by fishing new areas in the mid-Pacific.

In pre-World War II years, the world's tuna industry was confined mainly to the seas around Japan ; the Mediterranean and adjacent Atlantic Ocean, and the Pacific Ocean off Central America.

Japan and the United States together caught over 80 percent of the entire production.

Since the war, the increased demand for canned tuna in the United States has stimulated world interest in the tuna fisheries. Operations have been expanded and new industries have been developed principally off the southern Pacific coast of the Americas and off western and northern Europe.

The world's catch increased from between 370,000 and 380,000 metric tons in 1939 to over 450,000 metric tons in 1951.

Further expansion is expected in currently productive areas and other warm regions.

Even where resources are abundant, however, the returns must be large enough to justify the purchase of high-priced vessels and the installation of refrigeration and canning facilities.

Because of the relatively high cost of producing tuna, continual expansion appears to be largely dependent on the maintenance and enlargement of the more highly-priced markets, in particular in the United States, for tuna products.

I. *History of the United States' Tuna Industry*

Tunas are one the world's leading fishery resources. Five species are taken generally by United States fishermen. These are albacore, bluefin, little tuna, skipjack and yellowfin tuna. In addition, bonito and yellowtail are packed tuna-style and known as "tuna-like fishes." However, they cannot be labeled "tuna" in the United States.

The United States catch, which has averaged about 160,000 metric tons annually in recent years, is one of the most valuable fisheries products taken by fishermen. Tuna canning began in the United States in 1903 when the canning of albacore was undertaken in southern California. For a number of years albacore was the only species canned. But as the demand increased and the supply of albacore was found to be limited, the packing of other species was begun. As the market for canned tuna continued to expand, the number and size of the fishing craft increased, and it became necessary to fish in waters off Central and South America where large concentrations of skipjack and yellowfin were available throughout the year. By 1927, the principal source of fish for Californian canneries was the waters south of the Mexican border.

In 1937, considerable quantities of albacore were found off Oregon and Washington, and tuna canneries were established in those states. Locally caught albacore, as well as receipts of these fish from California and imports of various species of tuna from Latin America and Japan, are now canned in Oregon and Washington.

The canning of tuna on the east coast of the United States was likewise begun in 1937, and the fish are now packed in several Atlantic coast states. Locally caught bluefin and little tuna fish from the Pacific coast and imports from Canada, Japan and Peru, provide

the raw materials for the East Coast canneries. A few years after tuna were first canned in California, canneries were constructed in the Hawaiian Islands. The two canneries now operated in the Islands pack both locally caught and imported tuna.

As the market for canned tuna increased, a number of countries began exporting fresh, frozen and canned tuna to the United States. Imports of fresh and frozen tuna (principally frozen), which are received free of duty, reached a pre-World War II high level of 5,000 metric tons in 1937, and then increased spectacularly following the war to 31,000 metric tons in 1952.

Japan began exporting canned tuna to the United States in 1931 ; by 1933, imports of tuna canned in oil, nearly all from Japan, were equal to 40.5 percent of the domestic pack. Since these Japanese imports were found to be produced at lower cost than similar United States products, the duty was increased from 30 percent to 45 percent *ad valorem*. This effectivelly reduced the imports. In 1943, as a result of a trade agreement with Mexico, the duty on tuna canned in oil was reduced to 22½ percent *ad valorem*. Following World War II, imports increased sharply and, in 1950, a total of 16,500 metric tons of tuna canned in oil were received, principally from Japan and Peru.

The Mexican Trade Agreement with the United States was abrogated as of 1 January 1951, which resulted in the duty returning to 45 percent *ad valorem*. The result of this action was to reduce imports of tuna canned in oil to only 1,600 metric tons in 1951, and 1,900 metric tons in 1952.

Since tuna canned in brine, rather than in oil, is dutiable at 12½ percent *ad valorem*, the Japanese began canning tuna in brine for export to the United States. In 1951, imports of this pack amounted to about 4,200 metric tons, and in 1952, to 8,600 metric tons.

III. United States Production

The major portion of the United States catch of tuna and tuna-like fishes is made with hook and line and purse seines. Relatively small catches are taken by pound nets, hauled seines and harpoons occasional incidental catches are made by gill nets and otter trawls.

Three types of fishing craft account for about 99 percent of the tuna catch. These are the small trollers or jig boats, which fish for albacore ; the large tuna clippers, which account for the bulk of the yellowfin and skipjack catch ; and the purse seiners, which engage principally in the taking of bluefin, bonito and yellowtail.

The fish are pre-cooked and most of the pack is canned in No. ½ cans with a small quantity of salt and vegetable oil. In recent years, there has been a strong trend toward packing chunks and flakes rather than solid meat.

In addition to the production of canned tuna, considerable quantities of tuna by-products, consisting of meal, and body and liver oils, and solubles, are manufactured from tuna waste. The total value

tuna by-products in 1952 was about U.S. $5,000,000. In the same ar, the value of the canned pack was U.S. $113,000,000.

Almost the entire 32 percent of the world production of tuna id tuna-like fishes accounted for by United States' fishermen is taken a the Pacific coast. Nearly all tuna clippers and some purse seiners e used solely for tuna and related species. Other craft engaged in e tuna fishery are also operated to a large extent in fisheries such . those for salmon, halibut, bottom fishes, pilchards, etc.

The tuna fleet, it is believed, is composed of craft on which little provement can be made to increase present efficiency of production. nless some revolutionary means of catching tuna is developed o a practical stage, there appears to be little chance of curtailing roduction costs through increased effectiveness per unit of crew effort.

Livebait is an important aspect of tuna fishery, since 70 percent f the total catch of tuna by United States vessels is made with it. n 1950 approximately 1 weight unit of live bait was necessary to ake 10 weight units of skipjack or yellowfin tuna, and a lesser amount or albacore. An estimated 11,800 metric tons of bait (foreign and omestic) was used by the bait boat fleet in 1950. About 17 percent of tuna bait boat's time at sea is spent in securing live bait. Between 5 and 90 percent of the bait supply is found in foreign countries. ome of these countries permit baiting by American vessels with vary- ng restrictions. A limited amount of research concerning synthetic ait has been started. Development of a suitable synthetic bait or substitute source of natural bait would benefit the tuna fishery.

Of the various locations from which the domestic tuna fleet might perate – other than the bases now used – the Equatorial Central Pacific area and the Gulf Caribbean area hold promise for future de- velopment as an expansion of, but not a substitute for, the present ishing grounds of the United States tuna fleet. The United States South Atlantic and Gulf of Mexico ports and the ports of Puerto Rico and the Virgin Islands have conditions attractive to the deve- opment of new tuna processing plants and vessel bases. But it is doubtful that the savings in any large scale movement would offset he disadvantages. The outlook for favorable changes in location of he entire tuna fishing fleet in the Pacific is similarly poor.

Development and/or expansion of the United States tuna industry s possible in three areas not now fished on a large scale, namely he Atlantic coast, the Gulf of Mexico and Caribbean area, and the eastern central Pacific. Recently acquired knowledge indicates that arge stocks of several species of tuna, as yet only partially or wholly unexploited, inhabit these waters within range of United States ports. The rate of development of these resources is difficult to predict because very little is known at present concerning the habits and actual abun- dance of the species, and the industrial expansion will be dependent, o a large extent, on the economic condition of the tuna market in coming years.

Bluefin have been caught by commercial fishermen in New Eng- and waters during the summer and early autumn for the past half cen-

tury or more. Annual production is small compared with the Pacific coast tuna fishery, normally ranging, in recent years, between 500 and 1,000 metric tons, with most of the catch coming from traps in Cape Cod Bay. Efforts to purse seine bluefin in the Gulf of Maine by commercial fishermen immediately prior to World War II, and by the Fish and Wildlife Service in 1951, resulted in good catches, but a low and unsteady local market for tuna discouraged commercial development. Since the war, tuna-canning activities have increased on the Atlantic coast, with five canneries in operation in 1952. The seasonal occurrence of large schools of bluefin in inshore waters indicates that the fishery may possibly be expanded further offshore, but the offshore potential is unknown. Adequate port facilities, the presence of large quantities of live bait, and a fleet of fishing vessels which could be readily adapted to long-line fishing, are factors in favor of expansion of Atlantic coast tuna fishing. In addition to the bluefin, little tuna and bonito are present in considerable, but unknown, quantities from Cape Cod to Florida.

Stocks of tuna on which to base a Gulf and Caribbean tuna fishery are known to exist. Development by United States fishermen is likely when and if our knowledge of seasonal occurrence and adaptations of fishing methods to the local conditions is sufficient. A limited fishery for little tuna in the Gulf is now possible if marketing problems can be solved. Extensive schools of tuna were observed in the Central Gulf in 1951 and 1952 by the Fish and Wildlife Service exploratory research vessel. The existence of a successful live bait fishery for tuna in Cuba lends encouragement to the possibility of exploiting Caribbean tuna with long-range vessels capable of following the seasonal migrations of the fish.

Rich new tuna fishing grounds were recently discovered by the Fish and Wildlife Service's Pacific Oceanic Fishery Investigations in Equatorial mid-Pacific waters south of Hawaii. Excellent long-line catches have been made over a wide area, indicating that considerable expansion of known producing grounds is possible. The majority of the tuna catch is made up of large yellowfin, some skipjack and big-eyed tuna. United States tuna seiners and large clippers are readily adaptable to long-line fishing and, on the basis of experimental catches, a United States vessel and crew of twelve might expect an average daily catch of from 3 to 6 metric tons in the most productive areas. There is a possibility of limited exploitation of surface tuna in the Line and Phoenix Island. Additional shore-side facilities are needed for any use of these islands as tuna fleet bases.

Most of the actual tuna fishing by United States vessels takes place on the high seas beyond the limits of claimed territorial seas. However, the tuna fleet regularly enters foreign territorial waters to capture bait, to utilize port facilities, and to fish for tuna in some locations. For these reasons, fishermen purchase licences and observe the fishing regulations of these countries. Albacore boats, purse seiners, and tuna clippers are affected in varying degrees by the foreign claims and regulations. Some 200 tuna clippers, working from

southern California to international waters off northern Peru, are totally dependent on live bait and are vitally affected by the limitations of territorial waters. Claims to territorial seas made by Latin American countries range from 3 to 200 miles offshore, although all are not enforced. Tuna bait, usually, is taken within three miles offshore, so these countries exert complete control over bait resources.

The ability of Latin American countries to develop local tuna industries will, undoubtedly, play a major role in future fisheries legislation. There are possible alternate sources of live bait, but they entail inconvenience and increased costs. Present research to develop artificial or alternate tuna baits is promising, and could relieve the tuna fleet from its almost total dependence on foreign supplies of bait. Results of recent exploration indicate that there are sufficient stocks of tuna in the high seas beyond all territorial jurisdictions to support the present industry, if some of the existing fishing grounds were closed.

Tuna plants are laid out, as a general rule, in the following manner. The plants face on a dock where fish can be unloaded from the fishing vessel. Cannery space adjacent to the dock houses thawing and butchering facilities, and when available, cold storage space. Pre-cookers, and sometimes retorts, adjoin this area. Cleaning and packing lines are located behind the pre-cookers, and the labeling and packing room is on the floor above. Rail facilities are at the rear of the plant.

Frozen raw loins and frozen cooked loins are two relatively new tuna products which Japan has shipped to tuna canneries in the United States in very limited quantities. The cooked loins are thoroughly cleaned and arrive at the plant ready for canning. Practically 100 percent recovery from the loins can be expected if the present difficulties with oxidation can be eliminated.

The production of frozen loins, whether raw or cooked, offers several advantages. Plant operators in Japan benefit through additional processing activities. Since only the usable portion of the tuna is shipped, United States plants benefit from reduced shipping costs. Use of the imported cooked loins also will result in a substantial saving in labor since few, if any, of the plant personnel normally employed in the butchering, pre-cooking, and cleaning operations will be required.

A newer product, which could seriously affect present tuna canning operations, is frozen, canned (unsealed), pre-cooked tuna. A sample lot of the product was prepared in Japan by packing precooked and cleaned albacore meat in No. ½ tuna cans and freezing the open cans of tuna. The frozen product was then shipped to a cannery in the United States for completion of the canning process. The process may be subject to a United States patent.

At least 50 percent of the weight of the whole tuna, as landed, is not canned. The so-called "waste" material is used to produce liver oils, solubles, liquid fertilizer, tuna oil and meal.

In some plants the livers are separated from the other visceral

material and processed into liver oil. In other plants all the viscera, including the livers, are used for the production of fish solubles and liquid fish fertilizer. The remaining waste, including fins, head, skin and bones, is converted into tuna oil and meal in the reduction plant.

The tuna canning industry utilizes its "waste" material as efficiently as any other segment of the domestic fishing industry. Efficiency in tuna canning might be improved either by saving labor or by increasing the yield of canned fish obtained per ton of raw fish processed. Since shore labor amounts to no more than 10 to 12 percent of total costs, chances for making any substantial reduction in costs by more efficient use of labor are not great. Substantial labor saving could be accomplished in the cleaning step if any of several different pieces of equipment, which are under development to clean tuna mechanically, should prove successful. A net saving in labor of perhaps 25 cents per case might be achieved. Other steps in the processing of tuna are fully or almost fully mechanized and any improvements which might be made could only result in very small over-all savings.

With the cost of the raw fish amounting to up to 70 percent of the total cost, savings resulting from increasing the yield of the canned product are potentially quite large. Over-all losses may be cut down considerably by more careful control but, if carried to an extreme, may alter the characteristics of the final product, and result in a pack of poor appearance with reduced protein content and nutritive value. Some improvement in yield is nevertheless possible, at least by some of the tuna packers.

On the whole, the tuna industry is making use of the latest developments and is operating at, or nearly at, maximum efficiency.

The texture of machine-packed fish may be somewhat different from that of hand-packed fish. This resuls chiefly from absorption of a greater amount of oil in the machine-packed tuna caused by a distortion of the muscle fibers of the fish in the packing machine, which in turn results in a greater capacity of the flesh to absorb oil. This greater absorption of oil, in some cases, leaves insufficient oil at the surface and may contribute to scorching during retorting.

Japanese canned tuna, being mostly hand-packed, has a somewhat smoother surface than the United States machine pack. The Japanese pack seems also to have been given a longer pre-cook than is customary with theUnited States pack, which results in it having a somewhat higher protein content. However, most of the canned tuna imported from Japan is now put up in brine, and such fish have a much lower oil content (as little as 2 percent oil or less) than the United States oil packs (which usually have from 10 to 20 percent oil). Such Japanese brine-packed tuna is also of a somewhat tougher texture.

Furthermore, the imported canned tuna usually has a flat, sometimes almost tasteless flavor as compared to the domestic product. This may be due to a variety of causes, including possible loss of flavor constituents either through holding the frozen fish for too long

a period of time or by overcooking it at the pre-cook stage. This loss of flavor is sometimes quite noticeable.

The State of California has extensive regulations concerning freshness of raw tuna and adequate processing methods in preparing the canned products. The industry is well satisfied with existing regulations and believes that they maintain the quality of tuna at a high level.

The United States Food and Drug Administration will be bringing out new standards for canned tuna within the next year or so. Meetings are still in progress concerning certain controversial aspects of the standards, particularly regarding the filling of containers.

For most canned food products, the amount of food material placed into the can ("fill-in" weight) can be estimated by determining the "drained weight" of the canned product. In the case of the canned tuna, however, the fish absorbs varying amounts of the added oil depending on the type of pack.

Color of the different packs of canned fish will be graded in the new standards giving three types, white, light and dark meat packs. The color, determined in a special instrument, will be stipulated for each grade. In addition to color grades, packs may be put up as solid-pack, chunks and flakes. Specifications may limit the amount of small pieces allowed in the solid and chunk packs to 15 and 50 percent respectively.

While many packers believe that the existing standard tuna pack is all that the housewife needs or wants, no large scale attempt has ever been made to put up a mass produced tuna product consisting of tuna and some other food ingredient(s) which would be ready to serve, merely by opening the can and heating. Several such products have been tried on a small scale in the past, but with the high cost of production (and consequently high selling price) they have never been popular. One of the large tuna packers is now in the process of bringing out such a mass produced product. A few members of the tuna industry believe that such products may greatly expand the demand for canned tuna, but until the success or failure of this new venture can be determined, it is impossible to predict the future of such items.

IV. Distribution in the United States

Of the three principal economic functions in bringing canned tuna to the consumer – production, processing, and distribution – the latter takes the smallest share of the consumer's dollar. Transportation, warehousing, wholesaling and retailing are the principal sub-functions in distribution.

Three principal transportation facilities are used to bring canned tuna from processor to market – railroad, truck, and intercoastal boat. The greatest volume of canned tuna is sent, via railroad, to most of the major distribution centers in the United States. Canned

tuna shipments to large cities on the west coast are handled mostly by truck. A small percentage of canned tuna is shipped to Atlantic ports via intercoastal boat, utilizing low rates and low minimum carload requirements.

Railroad transportation rates for many food commodities increased more than did railroad rates for canned tuna in the period 1950 through 1952. In general, transportation charges for canned tuna for these years were relatively low.

Wholesale marketing procedures are being improved by many new methods which focus on adjustments in merchandizing policies and physical operations. Improvements have been initiated to cut costs of taking and assembling orders ; to provide separate arrangements for handling special orders ; and to strive for better integration of plant and worker so that job timing will be the most efficient.

Wholesalers stocking canned tuna handle it in an identical manner to hundreds of other commodities. Therefore, an improvement in the over-all physical operation of warehousing will be an improvement in the wholesale marketing of canned tuna.

The marked growth of the " supermarket " type grocer and chain store operations have forced improvements in retail marketing procedure. Efforts have been directed towards improvements in the physical handling of groceries and merchandizing research. Any cost-reducing innovation by retail grocers will be to some degree an improvement in the retailing of canned tuna.

Wholesale and retail marketing of canned tuna is only a part of the overall operation of firms in these fields. The essential problem of wholesaling and retailing is not one that can be resolved in terms of any one particular product. The problem confronting both wholesaler and retailer is the general movement of numerous products and not just the specific movement of canned tuna. Wholesalers and retailers appear to have sold this commodity at lower re lative margins than other canned fish items handled.

Ninety percent of all tuna produced by United States fishermen is packed in the State of California, 70 percent of this being processed by three large concerns. The greatest portion of the pack is sold through food brokers, who receive a 3 percent commission on the face value of invoices. Prices charged are f. o. b. plant, with the transportation cost added to the buyer's invoice. Most packers sell on a cash basis allowing small discounts for prompt payment of bills. Principal purchasers of canned tuna are wholesalers, retail-owned co-operatives, and chain stores. A notable trend is the increased volume sold to chain stores in post-war years.

Larger tuna packing concerns extend a floor stocks guarantee, which is a guarantee to the purchasers against a packer's reduction in prices within a limited period of time.

Millions of dollars are spent annually in direct advertising by tuna processors, consisting mostly of name brand promotion, conducted nationally. Some large companies engage in co-operative advertising agreements stipulating that the processor will pay the buyer a cer-

tain sum per case on proof that the buyer has advertised the processor's brand.

Large processors store canned tuna in commercial warehouses at various distribution centers throughout the nation, so as to shorten the interval between order and delivery.

Except for the California pack, data are not generally published on a current basis. Information on stocks is lacking at all levels except for private data at the canner's level collected by a California packer's organization. Periodic studies of the regional consumption of canned tuna also are non-existent. Price data at the wholesale level is collected by the Fish and Wildlife Service for the Index of Wholesale Prices of the United States Bureau of Labor Statistics.

V. Consumption in the United States

Abundant supplies of meat, poultry, eggs, cheese, and other protein foods in the United States have always been a limiting factor in the demand for fisheries products. The consumption per head for fisheries products has not changed significantly since 1909. Technological improvements have resulted in a greater percentage of the catch being canned and, in more recent years, quick-frozen. Canned fish remains the most important processed fisheries product, both in value and quantity. The two leading canned fish products for human consumption, tuna and salmon, show divergent consumption trends, the demand for tuna increasing while that for salmon has declined.

United States consumers, on the whole, are accustomed to tuna canned in oil, and tuna canned in brine has not yet made significant inroads in sales to household consumers. However, the institutional market has almost entirely replaced the oil pack with the imported brine pack.

From the consumer point of view there are only two varieties of canned tuna – white meat (albacore), and light meat (skipjack, yellowfin, bluefin and little tuna). The white meat of the albacore commands a premium at most domestic markets. The more abundant light meat species make up most of the tuna pack. Increases or decreases in the use of the respective species for white or light meat packs is expected to be determined predominantly by the availability of each species in the raw stocks. The market for canned tunalike species will be supplied largely by foreign producers. Few attempts have been made to market other types of tuna products, but the successful experience of the meat industry, with its new products, offers hope.

Most housewives are in the habit of purchasing canned tuna by brand name. Institutional consumers on the other hand are primarily price-conscious.

The results of two government surveys indicate the substantial increase in the number of households consuming tuna as income moves upward.

UNTAPPED FISHERY RESOURCES IN CHILE

In 1952, FAO sent a fisheries biologist to Chile to assist the Government in the survey and appraisal of its fisheries resources and in the initiation of an extended program of biological investigation. The biologist, Dr. Erik Poulsen, completed his assignment in April 1952. The report, which he submitted to the Government, stressed the desirability of the continuation of this work and, in 1953, the Organization appointed Dr. Fernando de Buen for the job. Dr. de Buen has now completed a six months' assignment and has written a report. In the course of his activities Dr. de Buen recommended to the fishermen engaged in trawl fishing in Valparaiso Bay that they should make a number of hauls in deep waters along the border of the continental shelf at a depth of about 125 fathoms. This recommendation was acted upon and has yielded some extremely interesting results. Several species of fish little known, or constituting new records for Chile, were taken in the hauls from 100 to 250 fathoms, and this result alone is of value ; further, the catch in some of the hauls consisted of a prawn unknown to Chilean fishermen. Some of the catches of this prawn exceeded 1,000 lbs.

A sample of these prawns was received by the FAO Regional Office for Western South America in Santiago and the prawn was identified by Professor N. Bahamonde of the Chilean Museum of Natural History and by Dr. B. F. Osorio-Tafall as belonging to the genus *Heterocarpus* of the family Pandalidae. The prawn does not seem to agree with any of the *Heterocarpus* species reported in the available literature and Professor Bahamonde is making a detailed study of it. Specimens sent to Dr. Chace of the United States National Museum, Washington, D. C., by Dr. E. Reed, Chief, Biology Branch, Department of Fish and Game, Washington, D. C., U.S.A., were identified as belonging to a species closely allied to *Heterocarpus hostilis* Faxon.

This species, according to Chace (*in litt.*) is not recorded in the literature since its description in 1895 and was established in specimens from the area between Panama and the Galapagos Islands in depths of 695 to 1,020 fathoms. In some of the hauls off Valparaiso a penaeid *Hymenopenaeus dismedae* appears occasionally in small numbers.

From the economic point of view the importance of this discovery is that the prawn proves to be of commercial value, finding a good demand and high prices in the Santiago market. It compares favorably with the excellently flavored langostino or plated lobster (*Cervomunida johni*), a Galatheidae, commercially fished in Valparaiso Bay. It appears that this prawn occupies, within the biotic community to which it belongs, an ecological niche similar to that of *Pandalus borealis*, the deep sea prawn of the Norwegian coast.

Conferences and Meetings

Indo-Pacific Fisheries Council (IPFC)

The Indo-Pacific Fisheries Council held its fifth meeting in Bangkok, Thailand, from 22 January to 5 February 1954, under the chairmanship of Dr. R. Serene, Director, Institut Océanographique, Nha-Trang, Viet-Nam. Delegates and advisers attended from 13 of the 16 member countries, namely : Australia, Burma, France, India Indonesia, Japan, Korea, Netherlands, Pakistan, Thailand, the United Kingdom, the United States and Viet-Nam. Dr. A. Wolsky, Head of the UNESCO Science Co-operation Office for South-east Asia, represented UNESCO ; Dr. Ernest Hess, Rome, and Dr. Cecil Miles, FAO Regional Officer for Asia and the Far East and Secretary of the IPFC, Bangkok, attended on behalf of FAO. The United Nations, the South Pacific Commission, Laos and Portugal were represented by observers.

The Council reviewed the work of its two technical committees since the last council meeting. Technical Committee I report covered the advances achieved in the collection of information on pollution of natural waters, on Hilsa and Chanos investigations, neritic – pelagic, oceanic (including tuna) and miscellaneous fisheries (including plankton studies, hydrology, taxonomy, etc.). Technical Committee II report included information collected on indigenous methods of gear preservation. The hope was expressed that the work of the Council would gradually advance from the present fact finding level to more effective analyses and evaluations of the data, the formulation of research plans on the basis of mutual co-operation and the execution of specific projects by the Council.

To simplify the procedure of the Council, it was agreed that the new Technical Committee I should divide into three panels to deal with inland fisheries, sea fisheries and miscellaneous fisheries ; and technical Committee II into three panels, to deal with fishing craft and gear, food technology and socio-economics, including marketing and statistics. In laying plans for the work of the panels in the period before the next Council meeting, emphasis was put on investigations into the effects of multi-purpose water development schemes on the fisheries, the determination of specific damage to inland fisheries due to water pollution, the necessity for the formation of a regional research unit on Chanos, continuing work on Hilsa and tuna, and co-operative research on *Rastrelliger*, the publication of all available salinity and temperature data for the region, and the continuation of the studies on shrimp fisheries. The latter subject was chosen for the symposium at the next Council meeting. The work program of Technical Committee II included development of beach landing craft, mechanization of craft and gear, exploratory fishing for shrimp, etc., preparation

of descriptions of fish processing methods in the region, a handbook on the "Principles of Fish Handling and Processing," and the study of improved methods of producing and storing dried fish under tropical conditions.

In discussing the Expanded Technical Assistance Program the establishment of a training center for master fishermen was urged. As the language problem, differences in fishing environment, etc. militated against such a course on a regional basis, it was suggested that several such courses be held on a sub-regional basis and that other technical assistance organizations be asked to co-operate.

It was decided that for the sixth meeting the technical papers to be presented should emphasize the definition of methods of approach to the solution of problems associated with the increase or maintenance of fish production. The Executive Committee was instructed to prepare, for presentation at the sixth meeting, a complete review of the work of the Council since its inception and the results, both direct and indirect, that have been achieved.

Nai Boon Indrambarya, Director-General of the Thai Fisheries Department, was elected chairman for the coming period, and Mr. J. A. Tubb, Director of the Fisheries Research Unit of Hong Kong University, vice-chairman.

The Executive Committee held a short meeting on 5 February, and agreed to hold its second meeting, 1954/55, at Bogor, Indonesia.

The 6th Meeting of the Council will be held in Tokyo, in October 1955, at the invitation of the Japanese Government.

International North Pacific Fisheries Commission

The first meeting of the International North Pacific Fisheries Commission, held by representatives of Canada, Japan and the United States, took place in Washington D.C., U.S.A., 1 to 12 February 1954. The establishment of the Commission is provided for in the International Convention for the High Seas Fisheries of the North Pacific Ocean, which was signed in Tokyo on 9 May 1952 by Canada, the United States and Japan, and which came into effect on 12 June 1953, upon the exchange of ratifications in Tokyo by the three governments. Observers attended from FAO, the International Pacific Halibut Commission, the International Pacific Salmon Fisheries Commission, the International Commission for the Northwest Atlantic Fisheries and the Inter-American Tropical Tuna Commission.

This being the first meeting of the Commission, a great part of the time was devoted to organizational and procedural matters. During the second week consideration was given to the Commission's responsibilities in the field of fisheries research. Two Standing Committees were established: the Committee on Finance and Administration, and the Committee on Biology and Research.

Officers elected were: Permanent Chairman (for one year), Stewart Bates (Canada); Vice-Chairman, Iwao Fujita (Japan); Secretary, Edward W. Allen (U.S.A.). The posts of Executive and Assistant

Executive Director will be filled at a later date. It was decided that the Committee on Biology and Research would meet in Tokyo, Japan, 17 May 1954.

The temporary headquarters of the Commission will be at the University of British Columbia. The next meeting of the Commission will take place on 25 October 1954, either in Victoria or Vancouver, B.C., Canada.

UNESCO Advisory Committee on Documentation in the Natural Sciences

The first meeting of this Committee was held in Paris, 15 to 17 February 1954. Observers were present from the World Health Organization, the World Meteorological Organization, and the Union of International Engineering Organizations; Dr. G.L. Kesteven represented FAO. A large agenda, relating to most aspects of documentation, was discussed.

Fisheries Division Activities

Obituary

We regret to learn of the death of Professor Jean le Gall which occurred on 6 February 1954, after a long illness.

He was born at Brest, in Brittany, France, in 1894 and from 1924 was a member of the Office scientifique et technique des pêches maritimes. For many years he was head of their laboratory at Boulogne; in 1942, he became head of the Biological Service in Paris, and in 1945 was appointed director. In laboratories as well as on board the *Président Théodore Tissier* he carried on important research work which did much to contribute to the development of the fishing industry, especially in regard to herring and tuna. Professor le Gall had a world-wide reputation and carried on important duties in various international organizations. As early as 1926 he took part in the International Council for the Exploration of the Sea (ICES); in 1946, he became chairman of its Atlantic Committee and in October 1952 was elected first vice-president on the ICES. In 1951, he became the General Secretary of the International Commission for the Scientific Exploration of the Mediterranean, and it was due to his perseverance that this body was able to resume the activities which were interrupted in 1939. From 1951 he was a member of the FAO Interim Committee on Fish Handling and Processing.

The General Fisheries Council for the Mediterranean (GFCM) is especially indebted to Professor le Gall as in 1949, when head of the French delegation, he took part in the drafting of the basic agreement.

In 1952, he assumed the duties of Chairman of the Council at the inaugural meeting and later was elected to that post. In 1953, at the Rome meeting, he stated that he did not wish to stand for re-election owing to the pressure of work from his other duties and his failing health, but he continued to work as Chairman of the Exploration Committee and through him this Committee considerably developed its activities and a very close co-operation was established between the GFCM and the International Commission for the Scientific Exploration of the Mediterranean. The death of Professor le Gall is a great loss to the GFCM where his wide knowledge of fisheries matters and his experience in the international field has done much to assist in the launching and smooth working of the Council.

General Fisheries Council for the Mediterranean (GFCM)

The Executive Committee of the GFCM met in Rome, 26 to 27 February 1954. Present at the meeting were Professor Umberto d'Ancona, Chairman; C.D. Serbetis and T. Soljan, Vice-Chairman; and M. Girard, Secretary. Decisions were made with regard to the work programs, and the following program of work and special rapporteurs were proposed:

Exploration Committee

Biology of Crustaceans	Dr. R. Dieuzeide (France)
Biology of Clupeidae	Miss S. Muzinič (Yugoslavia)
Biology of Tunas	G. Belloc (Monaco)
Biology of Scombroids	L. Bellon Uriate (Spain)

Production Committee

Fishing Boats	Dr. G.G. Bordoli (Italy)
Gear and Fishing Methods	Capt. Luka Ruič (Yugoslavia)
Administration and Regulations	F. Villarem (France)
Vocational Training of Fishermen	Cmd. G. Bonamico (Italy)
Locations and Seasons for Fishing	José Amengual-Ferragut (Spain)
Working Conditions	Dr. R. Cusmai (Italy)

Utilization Committee

Transport and Refrigeration of Fish	—
Salting and Smoking of Fish	Dr. R. Dieuzeide (France)
Preserves	M. Boury (France)

Pickling	A. Feletti Spadazzi (Italy)
Fish Markets	Dr. Emilio Ciuffa (Italy)
Fish Meal, Oils and By-products	–

Inland Waters Committee

Water Pollution	Professor Carlo Maldura (Italy)
Fish Culture in Saline Lagoons	Professor Umberto d'Ancona (Italy)
Carp Culture in Paddy Fields	V. Tonolli (Italy)
Carp Culture in Ponds	Professor K. Reich (Israel)
Fishery Development in Barrage Lakes	M. Charpy (France)
Trout and Trout Culture	Miran Svetina (Yugoslavia)

Statistical Committee

Catalogue of Edible Marine Animals	
(*a*) Latin Names	
Fish	Professor Enrico Tortonese (Italy)
Molluscs	- Bacci (Italy)
(*b*) National Names	Professor Giorgio Bini (Italy)
Present Condition of Statistics	S. Zupanovič (Yugoslavia)

The third plenary meeting of the GFCM will take place in the Principality of Monaco, 5 to 9 October 1954.

Travel : Headquarters' Officers

On the invitation of the Government, Dr. D.B. Finn and M. Girard visited Egypt from 1 to 15 February in order to make a brief reconnaissance survey of some aspects of fisheries in that country. Special attention was given to the management of coastal lakes and to the development of sea fishing, particularly in the Red Sea. On his way back Dr. Finn stayed a few days in Turkey to consult with the Turkish Fish and Meat Office, and to review the activities of the FAO ETAP team in that country.

Dr. E. Hess left on 17 January to attend the 5th Meeting of the Indo Pacific Fisheries Council in Bangkok, and returned to Rome on 1 March. On his way back to headquarters he visited Malaya, Singapore, Ceylon, India and Pakistan to consult with the ETAP experts there.

Dr. G.L. Kesteven visited the Office des pêches maritimes while in Paris during February. In Brussels, he had discussions with M. Huet, Director of the Station des recherches des eaux et forêts, Groenendaal, and then visited the Sea Fisheries Station at Ostend.

Regional Fisheries Office for Latin America

Dr. B. F. Osorio-Tafall participated as moderator of a round table discussion on Population and Natural Resources at the Summer School of the University of Chile, and gave five lectures during the four weeks' course on fisheries development in Chile organized, under the sponsorship of the Department of Fish and Game, by the school teachers in Viña del Mar.

Preliminary tests were made on the use of the new Vio-Bin flour ; and a report is being prepared on Chilean plans for the manufacture of fish meal.

To continue the fish propaganda campaign carried out by FAO/ETAP expert J. Fridthjof, a co-ordinating office has been established by the Department of Fish and Game under Dr. Virginio Gomez, who previously worked under Mr. Fridthjof.

The Director of Fish and Game has requested Dr. Osorio-Tafall to assist in the drafting of a co-operative program for fishermen.

Regional Fisheries Office for Asia and the Far East

The activities of the Regional Office have been principally concerned with the 5th Meeting of the Indo-Pacific Fisheries Council held in Bangkok 22 January to 5 February (*see* pp. 77). The following documents relating to this Meeting have been issued :

Summary report of proceedings,
Technical and symposium papers,
Minutes of each session.

Other documents now made available include :

Proceedings of the 4th Meeting of the Indo-Pacific Fisheries Council.

IPFC *Special Publication* No. 2. " Fish Culture in Indonesia, " by A. E. Hofstede, R. O. Ardiwinata and F. Botke.

" List of Scientific and Other Periodicals Published in the Indo-Pacific Area. " 2nd edition (revised).

Expanded Technical Assistance Program

Resumé of progress in technical assistance in fisheries as o 1 April 1954.

British Guiana. W.H.L. Allsop, the Government Fisheries Officer who is on an FAO fellowship on inland fisheries and fish culture

visited FAO Headquarters in Rome in January, and after a short visit to the fish culture project near Calcutta, has arrived in Thailand. In addition to studying the fishery program being developed there by the FAO/ETAP expert, Dr. S.W. Ling, Mr. Allsop attended meetings of the Indo-Pacific Fisheries Council in February 1954.

Ceylon. The Acting Minister of Commerce, Trade and Fisheries, has presented a brass plate to the owner of the first local type Ceylonese fishing boat ever to have an engine installed in it. This engine was one of three 10 h.p. Diesel engines provided by FAO, and installed in local fishing craft in 1952/53. These engines are now being formally made over to the Ceylon Government so that the fishermen may exercise their option to purchase on advantageous terms. Alan Glanville (U.K.) reports further in connection with his small craft mechanization program that the Colombo Plan are following up his pioneer work for FAO by importing about 40 small engines suitable for installation in local craft. Further engines are being imported through commercial channels in response to the growing demand among fishermen. Meanwhile, one of the Danish-built 22-foot boats imported on Mr. Glanville's advice by the Government, has had excellent result in bonito fishing, the season for which began in December ; a second boat will join in this activity as soon as possible.

Einar Kvaran (Iceland) has been giving regular training to assistant marine engineers, and this work is combined with a program of routine over-haul and repair of the machinery in the various fishing vessels operated by the Department of Fisheries for which these engineers are responsible.

At the request of the Government, the fishery economist who was to have been recruited for service in July has been deferred, and a fish culture biologist for work on brackish and fresh water fish production is requested instead.

Chile. In addition to the fishery technologist whose assignment is due to begin in July on handling and distribution problems, a fishery engineer will be required in April to start a program of small craft mechanization and work on improved gear.

The final reports of Dr. de Buen (Mexico), fishery biologist, and John Fridthjof (Denmark) marketing economist, are being reviewed in Rome.

One Fellow is engaged in courses of study. Marcello Montt, economic and legal advisor to the Chilean Bureau of Fisheries, after a period of study at FAO Headquarters in Rome, is now working in Sweden.

Costa Rica. A shrimp biologist has now been appointed to work on a co-ordinated program in both Costa Rica and Panama.

Dominican Republic. S.Y. Lin (China), within a period of eight months in the country, and with considerable co-operation from the

Government, has had 15 ponds constructed ; and not only has stocking material been obtained from a corresponding project in Haiti, but reproduction of carp and *Tilapia* have been successfully achieved. Growth has been satisfactory, and the first marketing trials of carp in December were encouraging. A second propagation and administrative center is planned, and rough release in natural waters, which has been so successful in Haiti, will be carried out this year. Further development work will go hand-in-hand with training local personnel.

Ecuador The report by Carlos Gonzales (Argentina) on his mission regarding fishery technology has been sent to the Government. This work will be followed up in the second half of 1954 by the assignment of a fishery technologist, who will assist the Government in establishing a fish curing station on a pilot plant scale. Claudio Reyes, a fishery scientist of Ecuador, has begun working under an FAO ETAP fellowship at the Fishery Laboratory of the French Government at La Rochelle.

Egypt. A visit was paid to Egypt during February by Dr. D.B. Finn, Director of FAO Fisheries Division, and M.J. Girard, Regional Fisheries Officer for the Near East, during which the problems requiring attention under the FAO ETAP Program in 1954 were clarified. An inland fishery and fish culture biologist and a fishery statistician are being recruited for service in the second half of the year.

Finland. Two Fellows have completed their studies in the United States and Canada on fishery administration and fish meal manufacture. Two Fellows are at present studying in the United States, one on inland fishery biology and the other on fish hatchery management. Two further Fellows will begin work this year. The project concerned with the development of the fish meal and oil industry has been deferred.

Haiti. With the completion of the fish propagation and administrative center, the success of carp and *Tilapia* appears to be assured, from the production and m rketing points of view. The pond fish culture program was initiated by S.Y. Lin and developed during 1953 by Shimon Tal (Israel). Continued interest is shown by private farmers in building ponds in different parts of the country. Mr. Tal's present program consists in training staff of the administrative center, extension work among fish farmers, and a continuation of the rough release program which has proved very successful.

Honduras. The Government has now requested a more detailed survey of the possibilities of fish culture than the brief reconnaissance previously scheduled for this year, and it is planned that an expert will be assigned in the second half of the year for a period of six months.

Hong Kong. A Training Center on Fish Marketing will be conducted in July and August jointly by the Government of Hong Kong and FAO for fisheries officers from member countries of the Indo-Pacific Fisheries Council. In addition to courses of lectures on the principles of fish marketing, a study will be made of the methods and organization of the Hong Kong Co-operative Fish Marketing Scheme.

India. The report on the work of F. Botke (Netherlands), concerned with the development of the inland fisheries of West Bengal, has been issued. Paul Ziener, naval architect of Norway, has been working for the last six months in Bombay, Saurashtra and Kutch. Some nineteen fishing ports outside Bombay were visited, and on-the-spot advice was give to the fishery officer and fishermen themselves on motorization problems ; trials were carried out with recently installed engines to obtain data for use in future work in this area. Mr. Ziener is now moving on to Madras State where he has been joined by G.S. Illugason (Iceland), the fishery engineer whose program includes development of small craft mechanization and fishing gear improvements on both coast of this state.

Iran. The proposals for conducting a fishery exploratory survey in the Persian Gulf jointly with the U.S. Operations Mission to Iran matured too late for action in the current fishing season, but it is hoped to develop this survey during the whole of the next fishing season, starting about October and extending through to the following May. A fishery engineer will be assigned to this project by FAO ETAP at that time.

Iraq. An inland fisheries biologist will be assigned in April to study the effects of the great irrigation barrages on the migratory movements of food fish, and he will be joined in the second half of the year by a civil enginer with experience in the design and construction of fish passes and ladders.

Israel. The report by G. Napier (U.S.A.) on marine fisheries has been issued, and that by A.E. Hofstede (Netherlands) on inland fisheries and fish culture will be released shortly.

Liberia, H. van Pel, fishery engineer, continues on sick leave in the Netherlands ; J. van Pel will carry on both his own program on fish curing and his brother's on exploratory fishing until the end of March 1954. Plans for continuing the work of the fishery engineer are to be discussed with the Government.

Mexico. A draft agreement has been despatched for the consideration of the Mexican Government, which will provide for a Fisheries Training Center for Latin America in the second half of the year. Courses will be given primarily for fishery administrators, in fishery biology, technology and economics.

Pakistan. A combined report of the fishing boat design work of K.H. Magnusson and Curt Ohlsson, both of Sweden, will be issued shortly. This report will reproduce the lines of existing Pakistan sailing craft, and provide designs based on those of a new motor fishing craft of a type in the local tradition.

Panama. The work on shrimp biology carried out in 1952-53 by Leslie Scattergood (U.S.A.) will be continued in 1954 by Martin Burkenroad (U.S.A.), who will also work in Costa Rica on closely allied problems of shrimp populations.

Saudi Arabia. The appointment of a commercial fishery consultant is being deferred at the request of the Government, who have asked instead for a fishing gear technologist to assist in the commercial development of the country's fisheries through a newly created fishery corporation, sponsored by the Government.

Thailand. Dr. S.W. Ling (China) has continued his many-sided program of work in three main fields of endeavor, namely ; assistance in developing four inland fishery stations ; technical training of Thai fishery officers ; and assisting in the development of brackish and fresh water fish culture and of an extension fishery service in this field.

Turkey. Dr. G. A. Rounsefell (U.S.A.) has concluded his assignment in marine fishery research. He will be succeeded by O. Aasen (Norway), who will develop the Government's program of assessing available fisheries resources over the next twelve months. Helgi Bergs (Iceland) has been helping the Meat and Fish Office to make the most effective use of existing fish refrigeration and ice-making plants, and is advising the Office on its program of new fish cold storage construction. George Napier (U.S.A.) has made several trips in fishing craft belonging to the Meat and Fish Office ; actual fishing has, however, been restricted to surface trolling through lack of other fishing gear and equipment. It is hoped that purse seines will soon become available to enable intensive work to be commenced on the stocks of mackerel and anchovy in the Black Sea which will be fished more intensively in the future in connection with the proposed fish meal and oil plant at Trabzon. H.K. Henriksen (Norway) fishery economist, has completed a general survey of the fishery industry and of the fishery activities of the Meat and Fish Office, and is now formulating advice to increase its effectiveness in the discharge of its responsibility for catching, processing and distributing fish, and its administration.

One Fellow in fish processing methods is now working in Norway ; a second in fishery biology is working at the fishery biology laboratory at Lowestoft, England ; and a third in fish refrigeration will be working in Denmark in the spring, and a fellowship in fishery economics will be awarded in Denmark later this year.

Yugoslavia. The report of W. MacCallum (Canada), fish refrigeration technologist, has been transmitted to the Government. E. Tengberg-Hansen (Denmark), fish curing specialist, completed his assignment in

January and his report will soon be forwarded to the Government. He advised several fish processing plants generally on improved methods and, in particular, he showed how, by smoking and then canning, a new outlet could be found for hitherto unutilized resources of sprats which are available in some quantity for a short season.

John Fridthjof (Denmark) who has completed his work in Chile on fish consumption problems on an FAO ETAP program in 1951-53, has been assigned to a similar project in Yugoslavia. He assumed duty in January.

One Fellow has recently completed his studies on fish canning in Germany, Denmark, Morocco and other countries.

Program for 1954. It is now planned to provide the service of 25 fishery experts and to hold two training centers in the program which has been budgeted for the year 1954. Thirty Fellows will also be studying, eleven of whom were already awarded fellowships in 1953. The experts break down into six in inland fisheries and fish culture, four in marine fishery biology, three experts and both training centers in fishery economics, and fifteen in the various fields of fishery technology (food handling and processing : 4, fishery engineering and gear technology : 10, naval architecture : 1).

Current Fisheries Literature

Reviews

VS 9.10 FISHERIES RESEARCH — BIOLOGICAL UDC 57

e, B.B. The Occurrence of Lemon Sole Larvae in the Scottish
953 Plankton Collections of 1929, 1930 and 1931. (*see* VII, 1, 45)

ve, Richard van, and Seymour, A.H. The Production of Halibut
953 Eggs on the Cape St. James Spawning Bank off the Coast of British Columbia 1935-1946. (*see* VII, 1, 43-44).

rish, B.B., and Jones, R. The State of the Haddock Stocks in the
953 North Sea 1946-1950 and at Faroe 1914-1950. (*see* VII, 1, 43-44).

During the past decade there have been important advances in general theory of fish populations and of the effect on them of fishing operations. Perhaps the most significant of these will prove to be t contained in the treatise by Beverton and Holt (in press), of which e preliminary notice has been given (2,7) and through the MS, ch the reviewer has had the privilege of seeing. However, while eries workers are awaiting the appearance of this paper from the s, other papers (sometimes under obligation to this work) are ap-

pearing and contributing to the comprehension of the elements of thes systems, if not yet affording the means of completely effective inter vention which we would wish to possess.

The first two of these papers are concerned with the recruitmen properties of important stocks and are to be bracketed with Studie on Plaice, by Buchanan-Wollaston (4), Simpson (11), and Boerema (3) on Haddock, by Raitt (9); and on Atlantic Mackerel, by Sette (10)

Rae's paper reports the results of 2,905 hauls made with thre different nets during the years 1929, 1930 and 1931. He defines si stages of development from (and including) larvae to the most advance post-larval stages, and gives some evidence on the age of the stages he then reports by table and diagram the appearance of these stage and discusses them month by month from February to November His conclusions as to spawning period and places, dispersal of eggs an larvae and the vertical distribution of the larvae, brood fluctuations average sizes of the larvae, and the distribution of the most advance larvae in relation to the occurrence of the youngest bottom stages are then summarized under these headings.

Van Cleve and Seymour cover much the same ground (but fo eggs only) in respect of the halibut of the Cape St. James ground but, whereas Rae's data are drawn from 2,905 hauls in an area 6 by 15° during three years, which is roughly 8 hauls per degree squar per year, the halibut data are drawn from 3,240 hauls made at 1,08 stations in an area 4° by 2° during a period of 11 years, which i roughly 37 hauls per degree square per year; moreover, the halibu work was confined within each year to about half the number o months that the lemon sole work was carried out, and consequentl the sampling density of the halibut work was roughly 9 times (74:8 that of the lemon sole work. This difference in sampling density doubt less explains the differences of treatment in the two papers. In Rae' paper, the results are presented in tables, and are represented in ma diagrams; in van Cleve's and Seymour's paper, the data are presente on maps as contours of egg density, drawn according to the metho described by Buchanan-Wollaston (3). But more importantly, the hali but work permits greater statistical treatment of the data, and a examination of this more intensive treatment and comparison wit the lemon sole work prompts some doubt as to the validity of the co clusions reached in respects of the latter. In particular, one woul refer to the inconsistencies in Rae's Table 6, which are discussed b him and which signify clearly the technical problem, as yet unsolve of ensuring the correspondence of the catches taken by the plankto nets, with the actual populations of eggs and larvae.

Both of these papers are concerned with one of the major pro lems of fisheries research, namely the relation between spawning sto and subsequent recruitment. Theoretically, the investigational ope ations to be followed in determining this relation are the measureme of (*a*) fecundity, (*b*) spawning activity, (*c*) populations of eggs a larvae (and of development and survival within these), and fina (*d*) recruitment into fishable stocks. Rae's work was designed

" see whether any relationship existed between the numbers of larvae in the plankton and the subsequent adult brood strengths," and he had to record that the attempt to measure this correlation proved inconclusive ; but he goes further to conclude " that a good spawning does not necessarily result in a good survival brood and that moderate numbers of larvae may, on the other hand, under favorable conditions, produce good recruitment to the stocks," which is an observation also made by Sette (7). Van Cleve and Seymour were working with the idea that measurement of the number of eggs on the spawning banks would give some indication of changes in the spawning population ; they report that " Variations in abundance of eggs correspond with changes that have occurred in the stock although correlation between egg abundance and the spawning stock as determined from catch records and market landings is not significant," and " Correlation of egg abundance with recruits is not significant."

These conclusions might, quite easily, be made too much of in the debates which arise from differences of opinion concerning the relations between spawning and recruitment. In these debates there are some who have grave doubts whether fishing operations upon stocks of spawners exercise an influence on the fluctuations in abundance of the stock, or even on the average level of abundance. (Presumably they would vary in the vigor with which they would maintain that there was no influence ; some might hold simply that there might be such an influence which, however, would be negligible beside that of the natural factors). The opposing school is itself divided on the matter of the relation between, the spawning stock (and its fecundity) and the recruitment into the fishable stock. Some hold that an important and measurable relation exists, some that although there must be a relation it cannot, or need not, be measured and finally, some hold that, in effect, no relation other than the obvious one of continuity exists.

It may be that people who take such a position hold also that stock management can be accomplished on the basis only of measurement of the growth potential of the stock as a whole as though the stock were an organism whose changes in weight could be observed whilst the histological changes and cell multiplication could be taken as being represented by such weight changes, and need not be measured. But if this is the case, it would seem that some doubt might be cast on the validity of controls, such as legal minimum size (and the specification of appropriate fishing equipment), of which the intention was to protect reproductive potential and not specifically growth potential.

If there is no relation between the spawning stock and the recruitment, there seems to be no logical basis on which to propose a limitation of fishing in order to protect the spawning stock as such.

It thus seems to the reviewer that on present theory and evidence

there are three possible views to take on wild stocks of fishing in open water :

I. that no management on biological basic is necessary ;
II. that management should be planned to protect the recruitment properties of the stocks, as well as other properties ;
III. that management need be planned only to protect the growth potential of the stock.

These papers offer evidence of value to this discussion, but in evaluating this evidence it is necessary to consider the relation of the reported work to the entire complex of population factors contributing to the elements which these workers sought to measure. These elements are : the spawners, the eggs which they produce, the larvae, post-larvae, etc. which develop from these eggs, and young fish which survive to become the recruits eventually entering the fishable stocks. The factors which determine the numbers of these various elements are, of course, very many ; both papers contain lists of a selection of these factors : these have been combined, with modification, into a broader schedule which is given below. It should be noted that the technical problems of measuring the principal elements, and the factors which influence them, are not considered here.

1. Factors determining the numbers of eggs produced :
   (*a*) the size of the spawning population ;
   (*b*) the size and age composition of the population ;
   (*c*) hydrographic and other environmental changes inducing variations in the amount of spawn produced by the individual fish.
2. Factors determining the numbers of eggs on the banks at any given time within the season :
   (*a*) the length of the spawning season ;
   (*b*) spawning intensity within the season ;
   (*c*) the rate of development.
3. Factors determining the survival of eggs, larvae, post-larvae, etc.
   (*a*) Biotic factors causing mortality.
      (*i*) *Directly* : predation, disease and others ;
      (*ii*) *Indirectly* : competition for food.
   (*b*) Physico-chemical factors influencing :
      (*i*) the availability of food ;
      (*ii*) the rate and course of growth and development (temperature, salinity, motion) ;
      (*iii*) the intensity of biotic factors ;
      (*iv*) the distribution of the eggs and larvae, e.g. currents may transport eggs and larvae away from favorable situations.

In neither of these papers has the full range of factors been measured simultaneously with reliable sampling of the populations of

eggs and larvae. In the case of van Cleve and Seymour one would have expected a fuller use of available data in forming an *a priori* estimate of the total numbers of eggs spawned within each season and of the average numbers present on the banks per unit period of time. There is a section of the paper which is headed "Production of eggs on the Cape St. James Grounds," but the data dealt with relate to indexs of abundance of eggs as measured by plankton net hauls, and these, as discussion within the paper itself has stressed, are not the same as actual egg production. These matters are discussed in the methodological appendix of their paper, but it is noteworthy that in the section on variability of egg populations there is no mention of variations in reproductive potential arising from variations in size and age composition of the spawning population. Simpson (4) and other workers have shown clearly the relation between fecundity and age, length and weight, and one would have thought that the application of such results was fundamental to studies of this kind. * Again, although these authors give a brief estimate of the rate of survival of the eggs, there is no proper measurement of the factors involved.

Thus, without in any way questioning the value of these results, as they stand, and with recognition of the limitations to the field work itself, one can hold that the conclusions of these two papers do not support the view that the relation between spawners and recruits may be neglected; equally they give no indication of the importance which should be attached to such a relation.

One further observation may be made at this point. Whereas these papers have reference to the role of environmental factors in causing mortality and dispersal of eggs and larvae, [and in this field one's mind turns to the somewhat deeper study by Sette (7) in relation to the mackerel], Carruthers and his collaborators (9) make a study of recruitment in which the emphasis is thrown almost entirely upon the role of winds and currents as determinants of brood strength. Whilst there might be much in favor of such a treatment, there has been reluctance to accept it. The reviewer believes that when these two schools of thought find a common meeting ground there will emerge a workable hypothesis concerning this sector of the systems with which we are concerned.

It has been mentioned above that some workers may hold the view that stock management can be accomplished on the basis of measurement of the growth potential of the fishable stock as a whole; this necessarily involves some assumptions in respect of recruitment. The paper by Parrish and Jones which deals with the assessment of the haddock stocks on the Faroe Plateau and in the North Sea since 1914 and 1946 respectively, follows this line of thought, and at one stage of its argument assumes that the number of recruits of each brood are constant. It sets out to determine the relation between yield and fishing mortality during these periods and to determine the present level

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*The type of calculation is indicated by Table IX. in Kennedy's study of the whitefish in Great Slave Lake (8).

of yield in relation to the "maximum equilibrium yield." It takes, as starting point in its argument, a statement by Graham that " The productiveness of a fish stock depends on the effort used to exploit it, the productiveness first increasing and then decreasing as the effort increases." Taking the word " productiveness " to stand for " catch " this perhaps constitutes a sufficient statement of the general course of events viewed, as it were, entirely from outside, but once, as the authors do, one looks deeper into the system and takes cognizance of such matters as mortality and growth, this statement ceases. for the reviewer at least, to be a sufficient basis from which to attempt to define *biological* overfishing. There might at least be some deference to the views of those who hold that the effect of fishing is negligible beside the effect of natural factors. The authors then define " maximum fishing intensity" as " that fishing intensity which, when operative in a given area, on a self-contained fish stock over a number of years during which recruitment has been relatively steady, would give the maximum sustained yield from that area. " and from this they define biological overfishing as the situation in which there is greater fishing intensity than this defined maximum. From this theoretical basis, the authors proceed to the application of simple mathematical models to observed population data (i.e. to commercial statistics). Doubtless the logic and the mathematics of these models are sound, but one may be pardoned some scepticism concerning the practical value of an argument which relies upon so many assumptions. In particular, one must ask why the authors have not given the evidence which led them to assume " that the natural mortality rate rose to 17% annually " and to give, further, two other values for this rate. Again, whilst the authors might have good theoretical grounds for assuming that recruitment is constant, the reader would be forgiven if, remembering the work of Harold Thompson and others which showed that haddock broods varied considerably, he asked what these grounds were and what difference to the results would be made by the introduction of some measure of this variable into the calculations. He would be encouraged in this scepticism when, on turning to Figure 4 of this paper, and the discussion of it in the text, he found a discrepancy between the estimated and observed values of catch per 100 hours much greater than he felt should be expected from the application of a theoretical model. He might then feel disposed, as the present reviewer is, to turn back to the view that perhaps this work must appeal to more precise and direct measurement of the fundamental elements of these systems, namely, the recruitment, growth potential, and mortalities. It remains to be seen whether, for a useful management program, the recruitment is sufficiently measured more or less at the time at which it occurs or, in the sense of the discussion above of the first two papers, will require a technique of prognosis.

The central problem of fisheries biology is undoubtedly a population one — and this is said with due regard for the significance of community studies as these are distinguished from population work by Allee, Emerson, Park, Park and Schmidt (10), Dice (11), and

others. This is to say that while, on the one side, there is a broad field of work on the environment occupied by populations of commercial species, and on the other a field — perhaps equally broad — concerned with the technology and economics of the industry, the fisheries biologist has to deal with the location, structure, properties and dynamics of these populations. Yet despite the importance of this central biological field it cannot be held that the conclusions reached by investigations within it constitute over-ruling laws in respect of the management of the stocks, nor should this be held even where the dynamics involved concern the behavior of the stock in response to pressure and induced by fishing operations. On the contrary, it is to be held that the ruling conclusions are to be reached by political economy after fisheries science as a whole has offered its findings. Nevertheless, the detailed and extended investigations of fisheries biology are indispensable to the final statement, and the papers under review are notable contributions to this work.

A final point should be made concerning terminology. The term " bionomics " in the title is usually referred to the life history of the species and is given in more or less this sense in the Shorter Oxford Dictionary ; its use here to refer to population studies in economic context seems an unnecessary confusion. Again, " maximum fishing intensity " means what it says, but if the authors prevail in defining it in the sense given above, one wonders how, in future, one will refer to maxima appearing in time-series of statistics of fishing intensity.

G.L.K.

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1951 No. 5.

FWS 9.12 FISHERIES RESEARCH, BIOLOGICAL UDC 639.2.001.5

O'Connell, Charles P. The Life History of the Cabezon, *Scorpae-*
1953 *nichthys marmoratus* (Ayres). *Fish Bulletin* No. 93. California Department of Fish and Game, Marine Fisheries Branch, California State Fisheries Laboratory, Terminal Island Station, San Pedro, Cal. U.S.A. 76 pp., fig. tables, bibl. In English.

The cabezon is a species of negligible importance. Its greatest catch, in 1950, reached only about 22,000 lbs. Material for the study was obtained in markets from commercial fishing and in the cases of young adults and juveniles from special dip-net fishing. The account of the life history includes information on range and habitat, food and feeding, reproduction, larval development, the length-weight relation, age and growth, and color. Age was determined by reading otoliths.

FWS 9.1 FISHERIES RESEARCH, BIOLOGICAL UDC 639.2.001.5

Lozano Cabo, Fernando. Monografía de los Centracántidos mediterrá-
1953 neos, con un estudio especial de la biometría, Biología y anatomía de *Spicara smaris* (L.) [MONOGRAPH OF THE CENTRACANTID OF THE MEDITERRANEAN WITH A SPECIAL STUDY OF THE BIOMETRY, BIOLOGY AND ANATOMY OF *Spicara smaris* (L.).] *Boletín* No. 59, (Instituto Español de Oceanografía, Ministerio de Marina, Madrid, Spain) 126 pp., 42 figs. In Spanish.

Contains a study of the species of the family Centracanthidae which were rearranged in view of the fact that some characters previously used to separate them proved to be only dimorphic variations of the same species. An extensive biometric, biological and anatomical study of *Spicara smaris* is also given.

FWS 9.1 FISHERIES RESEARCH, BIOLOGICAL UDC 639.2.001.5(46)
— SPAIN

Spain, Instituto de Biología Aplicada, *Publicaciones* [PUBLICATIONS OF THE
1953 INSTITUTE OF APPLIED BIOLOGY] (Barcelona, Spain). Vol. 13, 186 pp. Vol. 14, 138 pp. In Spanish.

Vol. 13. Of the nine papers in this volume, three are of especial interest to fisheries workers. The first, by R. Margalef and M. Durán, deals with the microplankton of Vigo. There is also a paper by M.G. Larrañeta reporting observations on the sexuality of the *Pagellus Erythrinus* L. R. Zariquiey continues his studies on Spanish Decapods with a note on *Hippolytidae* of the north-east coast. A. Planas and F. Vives give a contribution to the study of the jurel (*Trachurus trachurus* L.) in the western Mediterranean.

Vol. 14. Of the four papers in this volume only one is of interest to fisheries workers, namely the paper by Larrañeta on the distribution of the young benthonic fish off the coast of Castellón.

FWS 1.2 FISHERIES INDUSTRIES — HERRINGS, UDC 639.222 (73)
ETC. — U.S.A.

Lee, Charles F. MENHADEN INDUSTRY — PAST AND PRESENT. *Fishery*
1953 *Leaflet* 412. United States Department of the Interior, Fish and Wildlife Service, Washington D.C., U.S.A. 17 pp. In English. Free.

Reviews the history of the Menhaden Fishery. Describes the early processing methods, comparing these with present-day methods. The catch today is estimated to be 2½ times that of 35 years ago, and the output of oil and meal is correspondingly greater. Reports a significant shift in the industry which appears to be based on a radical shift in the distribution of the Menhaden population, the early fisheries having been based on New England states, the present fishery being based on states further south, even into the Mexican Gulf. Fishing methods are described and the use of Menhaden and its products in the past are compared with present uses : the Menhaden meal is now highly esteemed as a source of high quality protein, minerals and vitamins which are used as veterinary foods. The catch of 75 years ago was estimated as being roughly 666 million pounds, and now at one thousand million pounds. It is indicated that the stocks have sustained heavy fishing for 75 years, but since they have disappeared from Maine, Rhode Island, Massachusetts, Connecticut, in turn, and although the catch from these states has now been replaced by catches from other states it cannot be said that the catch could be increased or even maintained at its present level and it is indicated that research is required.

FWS 1.1 FISHERIES INDUSTRIES — TUNAS, MACKERELS, ETC. — CUBA UDC 639.227 (729.1)

Howell, Luis Rivero. Los Escómbridos en Cuba — su biología e industrialización [The Scombroids of Cuba — Their Biology and Industrialization]. *Contribucion* No. 2, Centro de Investigaciones Pesqueras, Havana, Cuba. 103 pp., illus. In Spanish.
1953

Discusses the importance and history of the fishery for scombroids in Cuba, processing methods are described and an account is given of the species which are exploited including in each case notes on the biology.

FWS 2.6 FISHERY PRODUCTS, MARKETING — FRANCE UDC 65 (44)

Saint-Germain, J. Le marché du poisson [Fish Marketing], Office Dourdin, 33, Daunou, Boulogne, France. 110 pp., tables. In French.
1952

Reports a survey by a private company made at the request of the Union of Boulogne fishing boat owners, and gives information on the French fisheries industry and on the marketing and price of fish in France. Many references are made to the chapter devoted to France in the OEEC report on "Fish Marketing in OEEC Countries." The report concludes that the improvement of the quality and distribution of fish is a pre-requisite for the development of the French fishing industry.

FWS 9.10 FISHERIES RESEARCH, BIOLOGICAL — JAPAN UDC 639.2.001.5.(52)

Japan, Freshwater Fisheries Research Laboratory. *Bulletin*, Vol. 1 No. 1. 56 pp., fig., tables. Vol. 2, No. 1. 54 pp., fig., tables. Tokyo, Japan. In Japanese and English.
1952

No. 1 of Vol. 1 was apparently the only part of that volume issued. It contains the following papers: "Environment, Food Habit, Spawning, Development, Growth and Fisheries of *Zacco platypus* in Chikuma River," by K. Nakamura. An account of natural history studies of a cyprinid introduced from Lake Biwa to Chikuma River in 1929, with special attention to spawning habits. Some statistics of the fishery are reported.

"Study of Spawning Migration of Pond Smelt (*Hypomesus olidus*) by Marking in Lake Suwa," by Y. Shiraishi. Reports investigations on the pre-spawning migration made by this species under the ice within the lake toward the influent rivers which the species ascend. 1,012 tagged fish were released in January 1951, and of these, 27.9 percent were recaptured, nearly all within one month, and mainly near the estuary of the Rokuto River or within the river itself. These records, together with fishing statistics, furnish evidence on the migratory behavior of this species and on the intensity of fishing.

Race of Wild Goldfish with Special Reference to the Digestive Tract," by T. Kafuku. Reports the examination of 300 specimens of *Carassius auratus* caught in three localities, to determine whether the races or varieties of this species, which are recognized by fishermen and anglers, are taxonomically valid. The author concludes that he can confidently recognize three forms within this species, chiefly on the basis of evidence from the digestive organs.

Vol. 2 contains the following: "Study on Spawning Migration of Pond Smelt (*Hypomesus olidus*) by Marking in Lake Suwa (second experiment)," by Y. Shiraishi. Rates of recovery were higher than in 1951, being 41.7 percent as against 27.9 percent in the earlier experiment. An hypothesis of circulation of the fish within the lake prior to ascent of the influent rivers is offered.

" Limnological Survey of Lake Sagami, a Reservoir (1949-1950), " by Y. Shiraishi, A. Tokunaga, Y. Furuta and R. Kitamori. Lake Sagami is situated 25 km. west of Tokyo City. The survey was conducted from 1948-51 and covered water level fluctuation, water current, temperature, transparency, bottom deposit, pH, oxygen content, plankton and benthos. Fish production in the lake is discussed.

There is one other paper in Vol. 2. " Study of Farm Pond Fish Culture. No. 1. An Experimental Study of Chemical Condition in Fertilized Pond, " by Y. Matida.

The papers are generally in Japanese, but some are in English and always an extended English text is given, and tables and diagrams have English legends.

Journals and Periodicals

Australian Journal of Marine and Freshwater Research (Commonwealth
1952 Scientific and Industrial Research Organization, 314 Albert St.,
1953 East Melbourne, C.2., Victoria, Australia).

AFFLECK, R. J. " The Effect of Galvanized Iron Pipes on Water in a Trout Hatchery. " *Fisheries Contribution* No. 1.

————. " The Early Estimation of Percentage Fertilization in Trout Ova. " *Fisheries Contribution* No. 2.

————. " The Nacreous (Mottled) Group of the Goldfish (*Carassius auratus* L.), with an Analysis of the Colours seen in these Fish. " *Fisheries Contribution* No. 3.

————. " Zinc Poisoning in a Trout Hatchery. " *Fisheries Contribution* No. 4.

————. " The Stability of the Vitelline Membrane and Requirements of Developing Trout Ova. " *Fisheries Contribution* No. 5.

Bulletin de l'Institut français d'Afrique noire (Dakar, French West Africa).
1954 *Série A : Sciences naturelles.* Vol. 16, No. 1, January 1954.

DELAMARE-DEBOUTTEVILLE CL., and NUNÉS-RUIVO, L.P. " Parasites de poissons de mer ouest africains récoltés, par J. Cadenat. Copépodes. "

CADENAT, J. " Notes d'ichtyologie ouest africaine. Sur quelques espèce d'Apodes du genre *Caecula.* "

CHABANAU, P. " Révision des Soléidés du genre *Pegusa.* Description d'une espèce inédite. "

LE DANOIS, ED. " Résumé de nos connaissances actuelles sur l'Albacore ou Yellow fin tuna (*Thunnus albacores* Bonnaterre). "

MONOD, TH. " Contribution à l'étude du peuplement de la Muritanie, Poissons d'eau douce. "

Deep Sea Research. Editors : L. Fage, Cameron D. Ovey, and Mary Sears.
1953 (Pergamon Press, London). Vol. 1, No. 1, October 1953. Quarterly. 4 issues : £4.10.0d.

This journal will be devoted to the publication of work falling within the terms of reference of the Joint Commission on Oceanography of the International Council of Scientific Unions, i.e., the investigation of the deep sea floor and the water layer next to it, with its inhabitants. This first number contains the following papers :

WISEMAN, J. D. H. " International Collaboration in Deep-Sea Research. "

————, and OVEY, C. D. " Definitions of Features on the Deep-Sea Floor. "

PETTERSSON, H. " The Swedish Deep-Sea Expedition, 1947-48. "

HEEZEN, B. C., EWING, M. and MILLER, E. T. " Trans-Atlantic profile of total magnetic intensity and topography, Dakar to Barbados. "

BERNARD, F. " Rôle des flagellés calcaires dans la fertilité et la sédimentation en mer profonde. "

WISEMAN, J. D. H. and HENDY, N. I. " The significance and diatom content of a deep-sea floor sample from the neighbourhood of the greatest oceanic depth. "

RITCHIE, G. S. " Further notes on the greatest oceanic sounding and the topography of the Marianas Trench. "

Investigaciones zoológicas chilenas (Casilla 147, Santiago de Chile, Chile).
1950 First published in 1950. Vol. 1 consists of ten parts covering 1950-53. Vol. 2 was begun in October 1953. Each part consists of brief zoological notes of systematic ecological or physiological work. In Spanish.

Irish Fishing and Fish Trade Gazette (Official Organ of the Irish Sea
1953 Fisheries Association : Frederick Press, South Frederick Lane, Dublin, Ireland). Vol. 1, No. 1, September 1953. Fortnightly. 6d.

Unión de Fabricantes de Conservas de Galicia. *Boletín* No. 1 and No. 2.
1953 (Vigo, Spain). In Spanish.

The first two bulletins in this new series are translations into Spanish by Francisco Lopez Capont of works by Henri Cheftel — " La préparation des conserves de poissons aux Etats-Unis, " and " La valeur alimentaire des conserves appertissées. "

Administrative Reports

California Cooperative Oceanic Fisheries Investigation. *Progress Report*
1953 1 July 1952 — 30 June 1953. California State Fisheries Laboratory, Terminal Island, Calif., U.S.A.

Denmark, Fiskeriminsteriets Forsogslaboratorium. Årsberetning [ANNUAL
1953 REPORT OF THE TECHNOLOGICAL RESEARCH LABORATORY OF THE MINISTRY OF FISHERIES], 1953. Copenhagen, Denmark.

Germany, Bundesministerium für Ernährung, Landwirtschaft und Forsten.
1953 Jahresbericht über die Deutsche Fischerei 1952 [GERMAN FISHERIES: ANNUAL REPORT 1952]. Verlag Gebr. Mann, Berlin, Germany.

Inter-American Tropical Tuna Commission. ANNUAL REPORT FOR THE
1953 YEAR 1952. La Jolla, Calif., U. S. A.

International Commission for the Northwest Atlantic Fishers. ANNUAL PROCEEDINGS FOR THE YEAR 1952-53. (Halifax, N. S., Canada), Vol. 3.

Singapore, ANNUAL REPORT OF THE FISHERIES DEPARTMENT 1952. Govern-
1953 ment Publications Bureau, General Post Office, Singapore.

Uganda Protectorate, ANNUAL REPORT FOR THE GAME AND FISHERIES
1953 DEPARTMENT FOR THE YEAR ENDED 31 DECEMBER 1952. The Government Printer, Entebbe, Uganda.

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